

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BOMBARDIER RECREATIONAL PRODUCTS INC.

Petitioner,

v.

MHL CUSTOM INC.

Patent Owner.

Case No. IPR2024-01391

U.S. Patent No. 9,586,659

DECLARATION OF STEFANO BRIZZOLARA, PH.D
U.S. PATENT NO. 9,586,659
CHALLENGING CLAIMS 16-23 and 26-28

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I, Stefano Brizzolara, declare as follows:

I. INTRODUCTION

1. My name is Dr. Stefano Brizzolara. I am a Full Professor with tenure at Virginia Polytechnic Institute and State University (“Virginia Tech”). My position is in the Department of Aerospace and Ocean Engineering, where I have served as the Assistant Department Head and graduate program director from 2020 to 2023. In addition, I am a Virginia Tech Crofton Faculty Fellow for distinction in research.

2. I have been retained as an expert in IPR2024-01391 by counsel for Bombardier Recreational Products Inc. I have been asked for my expert conclusions regarding the validity of claims 16-23 and 26-28 of U.S. Patent No. 9,586,659 (the “659 patent”) (Ex-1001-USP659). For the reasons set forth below, it is my conclusion that claims 16-23 and 26-28 of the ’659 patent are invalid.

3. The ’659 patent was recently involved in a reexamination proceeding. During that proceeding, the patentability of the ’659 patent, including amended independent claim 16 and new claims 21-28 was confirmed. I have been asked to evaluate the patentability of some of the added (claims 21-23 and 26-28) or amended (claim 16 and claims 17-20 by virtue of their dependency on claim 16) claims (“challenged claims”). It is my opinion that the challenged claims of the ’659 patent are unpatentable over EvoloReport—which was not considered in the reexamination—and others such as Woolley and Frank.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

4. My qualifications are stated more fully in my curriculum vitae, which is attached as Exhibit A. Below is a summary of my education, work experience, and other qualifications.

5. I earned my M.S. in Naval Architecture and Marine Engineering (1994) from the University of Genova. I earned my PhD (2000) in Naval Architecture at the University of Naples Federico II (jointly with the University of Genova) with the thesis “Theory and Application of Numerical Methods for the Hydrodynamic Design of High Speed Ships”.

6. I was the founder of the MIT Innovative Ship Design Lab, a laboratory dedicated to the development of new design and design tools for innovative marine crafts that transferred and continue to direct at Virginia Tech. I was also the founder of Marine CFD Group, a research group at the University of Genova dedicated to the development and application of numerical methods for hydrodynamic in ship design.

7. As set forth in my CV (Exhibit A), my record of professional service includes recognitions from several professional organizations in my field of expertise, including the Royal Institution of Naval Architect, the Society of Naval Architects and Marine Engineers, and the American Society of Naval Engineers.

8. I am being compensated for my time at my ordinary hourly rate of \$500.

My compensation is not dependent on the outcome of these proceedings or the content of my opinions. To the best of my knowledge, I have no financial interest in either party or in the outcome of the proceedings.

III. MATERIALS CONSIDERED

9. In preparing this declaration, I have reviewed the claims, specification, and file history of the '659 patent. The '659 patent issued on March 7, 2017 from U.S. Application No. 15/064,521 filed on March 8, 2016. I understand that the '659 patent claims to be a continuation of U.S. Patent No. 9,359,044 ("044 patent"). I understand that the 044 patent issued on June 7, 2016, from U.S. Application No. 14/509,289, filed on October 8, 2014. The '044 patent states that it claims priority to U.S. Provisional Application No. 61/899,071, filed on October 10, 2013.

10. I have also reviewed and understand the reference and exhibits cited in this Declaration, including the following:

Exhibit	Description
1001	U.S. Patent No. 9,586,659 C1 ("659 Patent")
1002	Declaration of Stefano Brizzolara, Ph.D.
1003	Certified English Translation of Evolo slutrapport ("Evoloreport")
1004	Affidavit of Bjorn Lofgren Regarding Translation of EvoloReport
1005	Swedish-Language Version of Evolo slutrapport
1006-1010	RESERVED

Declaration of Dr. Stefano Brizzolara
IPR2024-01391 (U.S. Patent No. 9,586,659)

1011	U.S. Patent No. 6,443,786 (“Woolley”)
1012	RESERVED
1013	U.S. Patent No. 8,290,636 (“Manning”)
1014	RESERVED
1015	U.S. Patent No. 9,359,044 (“’044 Patent”)
1016	Prosecution History of ’044 Patent
1017	Prosecution History of ’659 Patent
1018	Declaration of Jakob Kутtenkeuler
1019	Affidavit of Ingmarie Rohdin Regarding English Language Translation of Batnytt Magazine Article; Swedish Language Version of Batnytt; English Translation of Båtnytt Magazine Article (“Batnytt”)
1020	Affidavit of Ingmarie Rohdin Regarding Translation of Batnytt Magazine Viewership Information for 2009; Swedish Language Version of Batnytt Viewership Information; English Language Translation of Batnytt Viewership Information (“BatnyttViewership”)
1021	Internet Archive Declaration of Nathaniel E Frank-White
1022	RESERVED
1023	Claim Construction Order from <i>MHL CUSTOM, INC. v. WAYDOO USA, INC. and SHENZHEN WAYDOO INTELLIGENCE TECHNOLOGY CO., LTD</i> , C.A. No. 21-0091-RGA
1024	Prosecution History of Application No. 90/015,269 (Reexamination of U.S. Patent No. 9,586,659) (“659-Reexamination”)
1025	U.S. Publication No. 2011/0111650 (“Braden”)
1026	U.S. Patent No. 5,544,607 (“Rorabaugh”)

1027	U.S. Patent No. 8,659,661 (“Frank”)
1028	<i>MHL Custom, Inc. v. Waydoo USA, Inc., et al.</i> , 1:21-cv-00091, DN153, Memorandum and Opinion (“Summary Judgment”)
1029	U.S. Patent No. 6,702,634 B2 (“Jung”)
1030	U.S. Patent No. 3,262,413 (“Bloomingtondale”)
1031	U.S. Patent No. 4,274,357 (“Dawson”)
1032	U.S. Patent No. 7,047,901 (“Chen”)
1033	<i>MHL Custom, Inc. v. Waydoo USA, Inc., et al.</i> , 1:21-cv-00091, DN31 and 31-1, Joint Claim Construction Chart (“Proposed Constructions”)

IV. LEGAL PRINCIPLES

11. I am not an attorney. For the purposes of this declaration, I have been informed by Foil’s counsel about certain aspects of the law that are relevant to my analysis, as stated in the following paragraphs. I have applied the legal principles in arriving at my conclusion expressed in this declaration.

12. I have been informed and understand that a patent claim is invalid if it would have been obvious to a person of ordinary skill in the art (“POSITA”) at the

time of the alleged invention recited in the claims. This means that, even if all of the requirements of a claim are not found in a single prior art reference, the claim is not patentable if the difference between the subject matter in the prior art and the subject matter in the claim would have been obvious to a POSITA at the time of the alleged invention.

13. I have been informed and understand that a determination of whether a claim would have been obvious should be based upon several factors, including, among others: (1) the level or ordinary skill in the art at the time of the alleged invention; (2) the scope and content of the prior art; (3) the differences, if any, that existed between the claimed invention and the prior art; and (4) and objective considerations of non-obviousness.

14. I have been informed and understand that when determining any difference between the invention covered by the patent claims and the prior art, one should not look at the individual differences between the patent claims and the prior art in isolation, but rather consider the claimed invention as a whole and determine whether or not it would have been obvious in light of all of the prior art.

15. I have been informed and understand that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a POSITA. Alternatively, the teachings of two or more references may be combined in the same way as disclosed in the claims. I have been

informed and understand that when deciding whether to combine the various items described in the prior art, the relevant question is whether the prior art combination would have been obvious to a person with ordinary skill in the art at the time of the invention. I have been further informed that it can be important to identify a teaching, suggestion, or motivation, in either the prior art or the knowledge of persons skilled in the art, that would have prompted a person of ordinary skill in the relevant field to combine the elements in the prior art in the way the claimed invention does.

16. In determining whether a combination based on either a single reference or multiple reference would have been obvious, it is appropriate to consider, among other factors:

- a. whether the teachings of the prior art reference disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
- b. whether a POSITA would implement a predictable variation, and would see the benefit of doing so;
- c. whether a POSITA would have recognized a reason to combine known elements in the manner described in the claim;
- d. whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and

- e. whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

17. I have been informed and understand that one of ordinary skill in the art has ordinary creativity and is not an automaton. I have been informed and understand that in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered. I have been informed and understand that a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art.

18. I have been informed and understand that to show a motivation to combine, one is not required to show how the references would be physically combined to render a claim obvious. The analysis is not focused on whether the features of one reference can be physically incorporate into the structure of another reference, but rather whether a person of ordinary skill in the art would have been motivated to combine the teachings of the references to achieve the claimed invention. For example, a person of ordinary skill in the art would understand how predictable variations of known concepts could be combined and would recognize that where multiple tools were available in a “toolbox” of a POSITA, any tool could be chosen.

19. I further understand that certain factors, commonly referred to as secondary considerations, if proved, may support or rebut the obviousness of a claim. I also understand that secondary considerations cannot be used to overcome anticipation. I understand that the Patent Owner bears the burden of proving secondary considerations in an IPR proceeding. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those having ordinary skill in the art at the time of invention, unexpected results of the invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I understand that there must be a nexus, that is, a connection, between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

V. LEVEL OF ORDINARY SKILL IN THE ART

20. I have considered the '659 patent from the perspective of a POSITA at the time of the alleged invention. A persona of ordinary skill in the art for the '659 patent would have had at least the equivalent of a master's degree in Aerospace or Naval Engineering, and one to two years of experience in the field of watercraft design and construction, particularly as that design and construction is related to

personal watercraft design and construction and/or hydrofoil design and construction. This level of skill in the art is appropriate because concepts of hydrofoil design and construction along with appropriate fluid dynamics to teach the skills necessary to design and construct hydrofoil-based watercraft are taught in master's level courses. These concepts that would be understood would include academic teaching of flight dynamics utilizing well known texts (such as Etkin, B., & Reid, L. D. (1995) Dynamics of Flight: Stability and Control. John Wiley & Sons). Moreover, an additional one to two years of experience in the industry would give one or ordinary skill in the art experience with how such systems are implemented in the real world. Before October 10, 2013, which would be the claimed priority date of the '659 patent if it relies on the '044 patent and the disclosures of its provisional application, I would have qualified at least as a POSITA under this standard.

VI. BACKGROUND TECHNOLOGY AND '659 PATENT OVERVIEW

A. The Alleged Invention

21. The '659 patent describes an improvement upon the powered hydrofoil surfboard by providing a personal watercraft that includes a hydrofoil that provides passive stability without the use of moveable surfaces. Ex-1001-USP659, 2:17-26.

22. Specifically, referring to Figure I below, the patent explains that the watercraft consists of four major components: a floatation board 101 for the user to occupy, a fixed strut 103 connected to the floatation device, a hydrofoil 102 with no

25. The hydrofoil of the watercraft of the '659 patent is designed to provide passive stability to obviate the need for active control systems. Ex-1001-USP659, 6:7-9. This passive stability was intended to allow the watercraft to mimic the feel and operation of a surfboard, which typically operate based upon the use of weight shift as opposed to control mechanisms such as moveable surfaces or thrust vectoring. Ex-1001-USP659, 1:42-48.

26. The '659 patent discloses multiple design choices that can be made with the hydrofoil to affect its ability to provide passive stability. Ex-1001-USP659, Fig 8, 5:35-65 (disclosing the use of fixed canards, winglets, horizontal tails, and vertical tails). In addition to these specific suggestions, the '659 patent notes that “achieving desired levels of stability and controllability” is done through a combination of “airfoil design, planform design, and tailoring the span-wise twist distribution to achieve desired outcomes.” Ex-1001-USP659, 2:22-25.

27. The '659 patent notes that the degree of passive stability provided by the hydrofoil can vary, because greater stability impacts the ability for the watercraft to maneuver. Ex-1001-USP659, 2:18-22 (“desired levels of stability”), 7:10-18.

28. Despite this disclosure regarding stability, the '659 patent does not describe an example watercraft or hydrofoil that, according to the patent, strikes a balance between passive stability and maneuverability. The '659 patent instead

leaves open the appropriate design, shape, function, and features for a watercraft and hydrofoil of a sufficient stability to those of skill in the art.

VII. OVERVIEW OF THE PRIOR ART

A. EvoloReport (Ex-1003)

29. EvoloReport is a design document describing the work conducted by a Master's Level course on Marine Design/Lightweight Design taught at Kungliga Tekniska högskolan ("KTH") in Stockholm, Sweden, *See generally*, Ex-1003-EvoloReport.

30. The EvoloReport consists of multiple design documents, reports, analysis, and appendices tracking the design and development of the Evolo project. *See generally*, Ex-1003-EvoloReport, 5-16. The layout and presentation of the EvoloReport is typical of master levels project work by students in the area of Aerospace or Naval engineering.

31. It is my understanding that the EvoloReport was authored by the instructors and students in a marine design / lightweight-design class. Ex-1003-EvoloReport, 2. Because I have determined that a POSITA has a master's degree plus one to two years of experience, I believe that the students working on the Evolo project did not meet the standards of a POSITA.

32. It is my understanding that the EvoloReport was uploaded to a website maintained by the instructor who taught the class at KTH. At the time of the priority

date of the '659 patent, it was very common for academics to maintain webpages regarding their research or the research that was being conducted by their research groups. In fact, I currently maintain a similar website disclosing the research being performed by the iShip lab research group at Virginia Tech (available at <https://www.aoe.vt.edu/people/faculty/brizzolara/personal-page.html>).

33. It is my understanding that an article regarding EvoloReport was published in a popular Swedish boating magazine, Båtnytt. Ex-1018-KuttenkeulerDecl. ¶¶29-30. It is further my understanding that Båtnytt published an article in its August 2009 issue, which described the watercraft disclosed in EvoloReport, including several photographs of the watercraft. Ex-1018-KuttenkeulerDecl. ¶¶29-30.

34. Because of POSITA is defined as a person who has both a masters as well as one to two years of experience working in the industry, a magazine such as Båtnytt would be typical reading and research material for a POSITA to keep track of developments in the industry. The industry experience of a POSITA would cause them to track popular publications and events related to watercraft and boats so that they would understand current trends, technology, and advancements in the field of naval engineering.

B. Woolley (Ex-1011)

35. Woolley is a patent that describes various aspects of a flying ski. According to Woolley, the ski provides “stability, lift and maneuverability [that] can be controlled by the rider to accommodate the rider’s particular skill level....” Ex-1011-Woolley at 1:35-38. The ski includes a number of components, including an elongate board 20, an elongate strut 36 extending perpendicular and downwards from the board, and a hydrofoil, which Woolley refers to as a planing blade 38. Ex-1011-Woolley at 6:15-21. The planing blade 38 includes a front blade 40 and rear blade 42 connected to the strut via a fuselage 44. *Id.* Woolley explains that the planing blade provides “stability, lift, and responsiveness.” Ex-1011-Woolley at 10:31-33. Woolley explains that the front and rear blades can include stabilizing fins 120, 122 and 152, 154. *Id.* at 11:6-9, 19-29, 13:38-40.

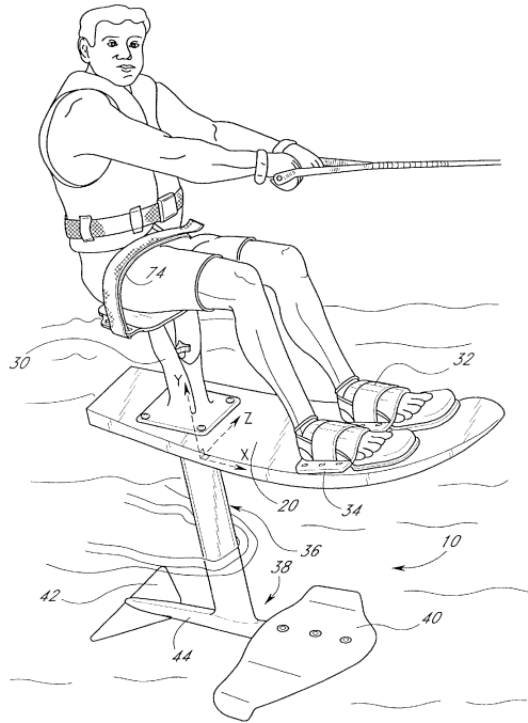


FIG. 1

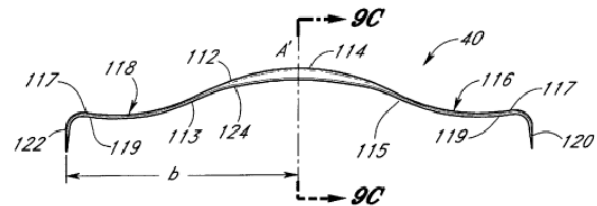


FIG. 9A

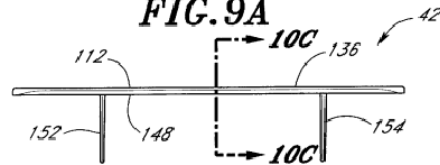


FIG. 10A

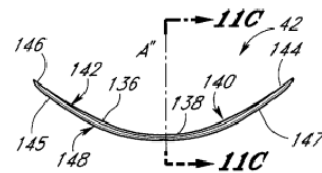


FIG. 11A

Ex-1011-Woolley, FIGs. 1, 9A, 10A, 11A

36. In view of at Woolley, a POSITA would understand the benefits of incorporating the stability components of the watercraft disclosed in Woolley into other hydrofoil watercrafts, regardless of whether they are towed by an additional watercraft. Woolley does not make any reference to the tow rope being a necessary component of stability, and instead focuses only on the fins and other features I described above.

A. Frank (Ex-1027)

37. Frank is a patent that is directed to safety systems for watercraft. Frank discloses an infrared imaging system 100A, 100B (e.g., an infrared camera) that has “an image capture component 130,” which is used to “capture infrared images”

around the perimeter of a watercraft. Ex-1027-Frank at 3:1-8, 7:26-40, 7:54-60. The infrared camera can be used to detect when a person has fallen off the watercraft. *Id.* at 19:26-34.

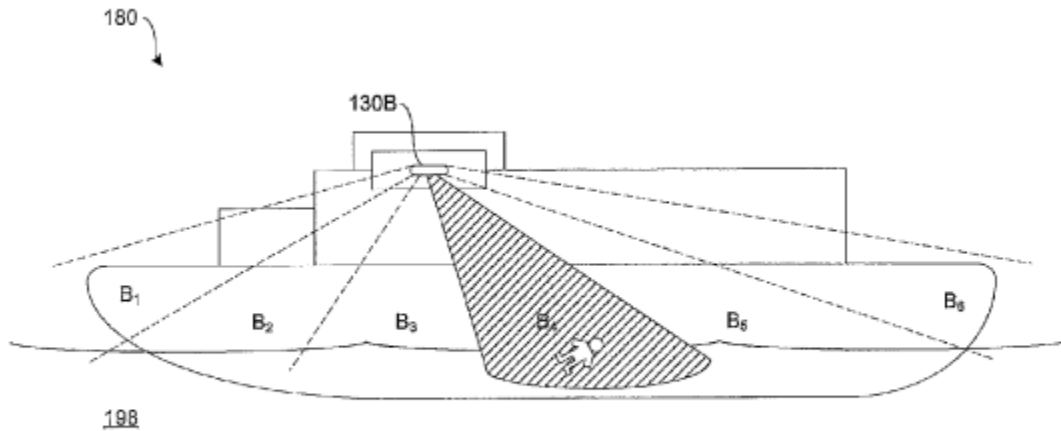


Fig. 1F

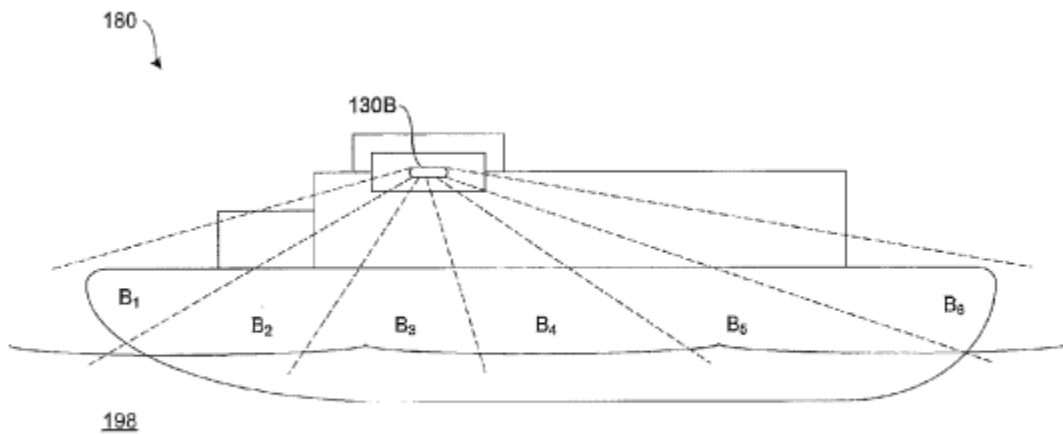


Fig. 1E

Ex-1027-Frank, FIGs. 1F, 1E.

38. The safety benefits of using the infrared imaging system disclosed in Frank to detect the presence of a user on any watercraft and to detect when a person

has fallen off any watercraft and into the surrounding waters would have been readily apparent to a POSITA. Such a system could also be paired with an audio or visual alert or notification to an operator to initiate a rescue action for the fallen individual. Ex-1027-Frank at 19:59-64.

VIII. CLAIM CONSTRUCTION

39. I understand that “claim construction” is the process of determining the meaning of a term or phrase in a patent claim. I have been informed that claim construction is a matter of law and that in this proceeding, claim construction will be determined by the Patent Trial and Appeal Board (“the Board”). I understand that the proper construction of a term is how a POSITA would understand the term based on its use and context in the claims, specification, and file history of the patent. I further understand that the claims are not to be reviewed in this proceeding under the “broadest reasonable interpretation” standard.

40. I understand that the following constructions have been proposed or adopted in litigation between patent owner MHL Custom Inc. and Waydoo USA, Inc.:

Term 1 (Claims 1, 16): “wherein a user can be disposed on the top surface of the flotation device in a prone, kneeling, or standing position”

Waydoo USA’s Proposed Construction: “Plain and ordinary meaning”

PO’s Proposed Construction: “Wherein a user can be disposed on the

top surface of the flotation device in each of the following positions:

lying chest down; kneeling; or standing”

Court’s Construction of Term 1: “‘Prone, kneeling, or standing’ are alternatives. Only one of them is required.”

Term 2 (Claims 1, 16¹): “A passively stable, weight shift controlled personal hydrofoil watercraft”

Waydoo USA’s Proposed Construction: “A weight-shift controlled personal hydrofoil watercraft that is stable without mechanisms or active control systems”

PO’s Proposed Construction: “A watercraft having a hydrofoil, the hydrofoil having an initial tendency to return to its original condition when disturbed without the hydrofoil having any moveable components and that is controlled by weight-shift of the user”

Court’s Construction of Term 2: “a weight-shift controlled personal watercraft having a hydrofoil that does not have any moveable components and which, when disturbed, (1) has an initial tendency to return to its original condition and (2) eventually returns to its original

¹ This term was added to claim 16 during reexamination as an amendment. I

understand that it was not previously construed.

condition”

41. In my opinion, the prior art discloses all of the limitations of the challenged claims under any plausible construction. I have been informed and understand that in such circumstances, there is no need to construe the terms in the challenged claims.

42. To the extent that I believe that the plain and ordinary meaning of a claim term needs to be discussed more fully, I will specifically do so in the report.

IX. SPECIFIC GROUNDS OF UNPATENTABILITY

A. Ground 1

43. As I explain below, claims 16-23 and 26-28 would have been obvious over the combined teachings of EvoloReport and Woolley along with the knowledge of a POSITA.

1. Claim 1

- (a) [1 Preamble] A passively stable, weight-shift controlled personal hydrofoil watercraft, comprising:

44. I have been informed and understand that, in general, there are circumstances where the preamble of a claim does not limit the scope of the claim and there are circumstances where the preamble does limit the scope of the claim. In any event, even if the preamble to claim 1 is limiting, EvoloReport discloses the claimed watercraft.

45. EvoloReport discloses a weight-shift controlled personal hydrofoil watercraft. Ex-1003-EvoloReport at 546. (“Evolo is a new type of watercraft that travels on a hydrofoil and is intended for one person. It is powered by an electric motor and is controlled only by means of center of gravity movement.”).

46. EvoloReport discloses that both pitch stability and rolling stability are factors in the design of the EvoloReport hydrofoil. Ex-1003-EvoloReport at 58-62 (“The purpose of this analysis is to establish a configuration of the hydrofoil so that it is stable in pitch.”); Ex-1003-EvoloReport at 88-98.

47. The term “stable” as used by the EvoloReport was being used to mean passive stability as contemplated by the ’659 patent (“By stable is meant that if Evolo is exposed to a disturbance, it will return to its initial position.”). Ex-1003-EvoloReport at 60.

48. A POSITA would have been motivated to combine the EvoloReport with Woolley along with their knowledge in the art to provide for a passively stable hydrofoil. Woolley discloses a hydrofoil that is fixedly interconnected with the lower end of a strut, the hydrofoil having no moveable surface and being designed to provide passive static stability controlled solely by weight shift of the user. Like EvoloReport, the primary embodiment disclosed in Woolley teaches a hydrofoil – or planing blade – comprising a front blade and rear blade interconnected by a fuselage. Ex-1011-Woolley at 6:19-21. Woolley notes that the purpose of the

planing blade is to provide a combination of “stability, lift and responsiveness.” Ex-1011-Woolley at 10:32-38. The ability to interchange different size front and rear planing blades in Woolley allows for providing “different stability, lift and responsiveness characteristics.” Ex-1011-Woolley at 10:30-42. In addition, Woolley discloses the ability to adjust the planform and angle of attack of the rear planing blade, based upon the level stability desired between a beginner through professional rider. Ex-1011-Woolley at 16:64-20:22. Thus, Woolley discloses solutions to the stability problems discussed and contemplated throughout EvoloReport.

49. Woolley discloses a front planing blade containing a chorded upper surface that tapers towards the rear so that the upper surface has a larger surface area than the lower surface, which causes an upward lifting force on the forward blade. Ex-1011-Woolley at 11:33-41.

50. Woolley discloses the use of the rear blade with a negative angle of attack, so that the rear blade creates a downward force on the rear blade. Ex-1011-Woolley at 17:20-36. The use of counteracting forces between the upward force caused by the forward blade of the hydrofoil and the downward force caused by the rear blade of hydrofoil is a well-known method for increasing pitch stability.

51. In addition to disclosing a hydrofoil that is stable in the longitudinal (pitch) plane, Woolley discloses a hydrofoil designed to be passively stable in the yaw and roll (lateral plane). As noted by the '659 patent, yaw and roll stability are

generally linked in hydrofoils. Ex-1001-USP659, 6:36-7:7. The '659 patent notes that yaw and roll stability can be achieved through “a combination of sweep and dihedral and can also be influenced with the addition of winglets or a fin.” Ex- 1001-USP659 at 6:63-65, Woolley discloses the use of each of the features in its hydrofoil, along with the desire to achieve stability in yaw and roll. The front and rear blades disclosed by Woolley are swept on at least their leading edge and on both edges in some embodiments. Ex-1011-Woolley at FIGs. 6A, 6B, 7A, 7B, 17:28-29. Woolley discloses a dihedral rear blade. Ex-1011-Woolley at FIG. 11A.

52. Both the forward blades and rear blades disclosed within Woolley show the use of winglets or fins at their ends. Ex-1011-Woolley at FIGs. 6A, 9A, 10A, 11A. Woolley discusses how these features are used to provide roll and yaw stability. Ex-1011-Woolley at 11:17-26 (“[t]he relatively large distance of the edge of the blade from the plane of symmetry A increases the moment created by water acting on the surface of the blade”).

53. Woolley’s disclosure of both pitch stability along with roll and yaw stability through the use of the hydrofoil discloses a hydrofoil designed to provide passive static stability. Ex-1011-Woolley at 13:47-53 (“When the generally planar surface...of the rear blade...operates together with the elliptical planing surface of the front blade..., these surfaces battle and counteract each other, providing the

desired stability characteristics. Specifically, these surfaces resist the turning of the ski from side-to-side or up and down, which is very desirable for beginners.”).

54. Woolley’s description of how it provides passive static stability far exceeds any disclosure within the ’659 patent regarding how to design a hydrofoil wing that is passively statically stable. The ’659 patent does not disclose how to design a hydrofoil wing that is passively statically stable, it simply enunciates well known aerodynamic conditions to mathematically satisfy stability and provides numerous examples of generic design choices that may provide passive static stability. *See e.g.*, Ex-1001-USP659 at 2:34-40 (“A fixed canard or horizontal tail surface can also be added to further improve passive longitudinal stability A fixed vertical tail can be added to improve lateral stability....”).

55. To the extent that the disclosed hydrofoil in Woolley could be found to not be designed to provide passive static stability, a POSITA would have sufficient knowledge to modify the disclosed hydrofoil in Woolley such that it would be designed to provide passive static stability.

(b) [1A1] a floatation device that has a fore-aft length greater than a lateral width, the floatation device having a top surface and a bottom surface,

56. EvoloReport discloses a floatation device that has a fore-aft length greater than a lateral width, with the floatation device having a top surface and a bottom surface. Ex-1003-EvoloReport, p546-550.

57. EvoloReport discloses the use of a floatation device described as a “floating body” as the portion of the disclosed watercraft. Ex-1003-EvoloReport, 550. The EvoloReport notes that the flotation device “has sufficient volume to...stay afloat with the driver.” Ex-1003-EvoloReport, 550.

58. EvoloReport further discloses a floatation device having an overall length (bow to stern) of C1, which is given as a length of 2313 millimeters. Ex-1003-EvoloReport at 546-547. EvoloReport discloses that its floatation device has an overall breadth (port to starboard) of A3, measuring 701 millimeters. Ex-1003-EvoloReport at 546-547.

59. This lateral width A3 of 701 millimeters is less than the overall aft length C1 of 2313 millimeters.

60. EvoloReport also discloses that the floatation device has a top-surface upon which a rider is disposed and a bottom-surface that is normally in the water during non-flying conditions. Ex-1003-EvoloReport at 550.

(c) [1A2] wherein a user can be disposed on the surface of the flotation device in a prone, kneeling, or standing position,

61. EvoloReport discloses that a watercraft designed for use with a “kneeling driver’s position” holding the handles on the top surface of the flotation device. Ex-1003-EvoloReport at 551.

(d) [1A3] the flotation device having a forward section, a middle section, and a rear section;

62. The claim terms “a forward section, a middle section and a rear section” are referenced in the ’659 patent as labels of the fore, middle, and aft sections of the floatation device. Ex-1001-USP659, 3:35-40; Fig. 1. A POSITA would have understood the plain and ordinary meaning of “forward section”, “middle section”, and “rear section” to simply be a section of the flotation device that is near or encompassing the forward end (bow) of the flotation device characterized by tapered waterlines and buttock (longitudinal) lines and a rising keel, a section of the flotation device near or encompassing the midpoint of the flotation device where the keel is horizontal and the maximum breadth is maintained, and a section of the flotation device near or encompassing the aft end (stern) of the flotation device, where the keel stays horizontal or rises and the hull beam reduces towards the end.

63. To the extent that the floatation device claimed in the ’659 patent “may be said to have” a forward section, middle section, and a rear section, the EvoloReport discloses a floatation device showing such sections. Ex-1003-EvoloReport at 546.

- (c) *[IB] a strut having an upper end and a lower end, the upper end fixedly interconnected with the flotation device between the middle section and the rear section of the flotation device.*

64. The EvoloReport discloses the use of a strut having an upper end and a lower end. Ex-1003-EvoloReport at 549-550.

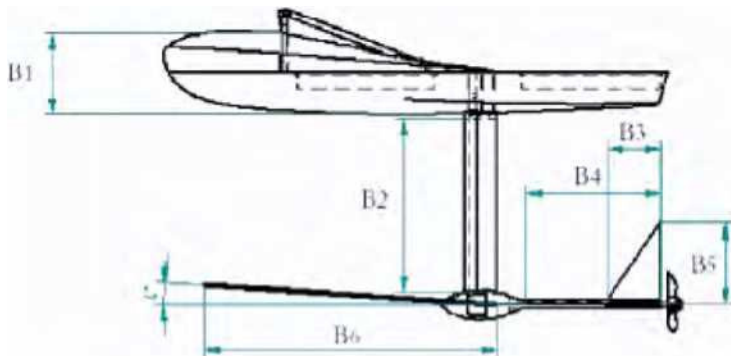


Figure. 10. Illustration of Evolo's strut

65.

Ex-1003-EvoloReport at 549.

66. The upper end of the disclosed strut in the EvoloReport is fixedly interconnected with the floatation device. Ex-1003-EvoloReport at 211-215. EvoloReport discloses the interconnection between the strut and the floatation device occurs aft of the midpoint of the floatation device.



Ex-1003-EvoloReport at 546

- (f) [1C] a hydrofoil fixedly interconnected with the lower end of the strut, the hydrofoil having no moveable surface and designed to provide passive static stability controlled solely by weight shift of the user

67. EvoloReport discloses a hydrofoil fixedly interconnected with the lower end of the strut. Ex-1003 -Evolo Report at 546, 549

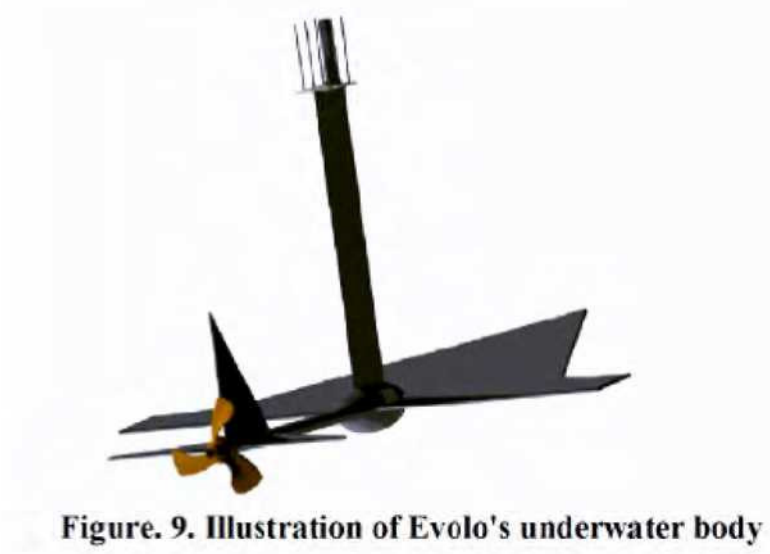


Figure. 9. Illustration of Evolo's underwater body

The EvoloReport further discloses that the hydrofoil has no moveable surface. Ex-1003-EvoloReport at 546, 549.

68. EvoloReport discloses that its vehicle was designed to be “controlled by means of a center of gravity shift.” Ex-1003-EvoloReport at 29.

69. The limitation “controlled solely by weight shift of the user” in the ’659 patent refers to the control of the entire personal watercraft, rather than the control of the hydrofoil separately from the personal watercraft. A POSITA would have understood that this control means longitudinal and directional control of the watercraft. The ’659 patent notes that “both longitudinal and directional control of the board is via weight shift.” Ex-1001-US659 at 2:9-11. The purported passive stability of the claimed hydrofoil allows “the watercraft to be controlled by weight shift rather than by mechanical system.” Ex-1001-USP659 at 5:65-66.

70. Because EvoloReport does not disclose any other moveable objects that would change the force of gravity on the disclosed watercraft, the weight shift of the user of the disclosed watercraft is the gravity shift disclosed in the EvoloReport. Ex-1003-EvoloReport at 29.

(g) [1D] a propulsion system for propelling the watercraft in a body of water, wherein the propulsion system is connected to the hydrofoil; and

71. EvoloReport discloses the use of an electric motor coupled with batteries and a propeller to provide a propulsion system for propelling the watercraft in a body of water. Ex-1003-Evolo Report at 551-552. The propulsion system in the EvoloReport is directly connected to the hydrofoil. Ex-1003-EvoloReport at 549.

(h) [1E] the watercraft having no movable steering system.

72. EvoloReport discloses the use of a fixed, unmovable handle for the rider to hold onto the watercraft and apply weight shifting. Ex-1003-EvoloReport, 551. The watercraft disclosed by the EvoloReport has no movable steering system.

2. Claim 16

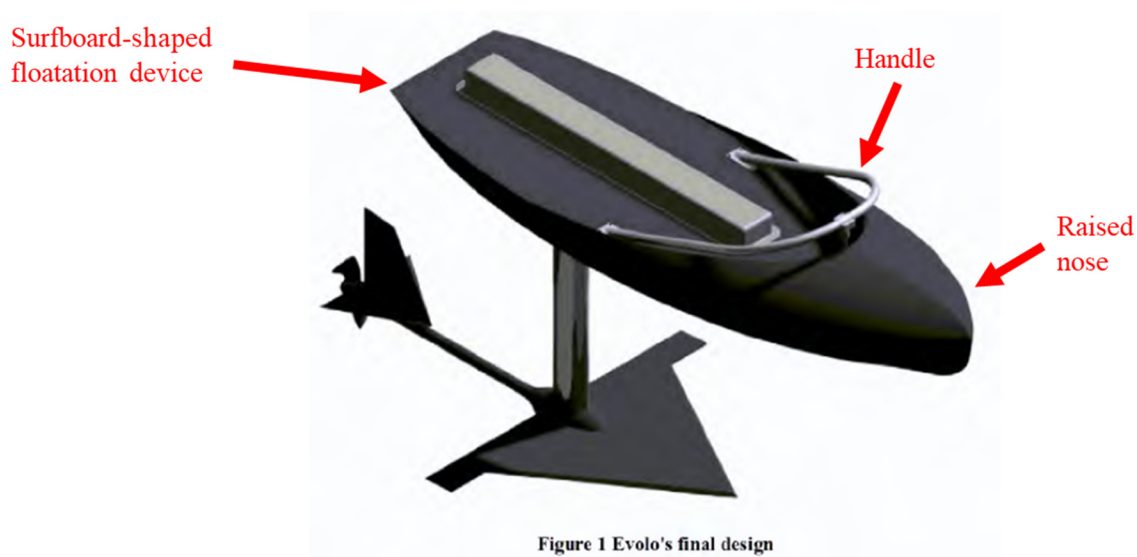
(a) [16Preamble] A passively stable, weight-shift controlled personal hydrofoil watercraft, comprising:

73. As discussed previously in ¶¶44-55 with regard to the preamble of claim 1, EvoloReport and Woolley disclose a passively stable, weight-shift controlled personal hydrofoil watercraft.

- (b) [16A1] a surfboard-shaped flotation device that has a fore-aft length greater than a lateral width, the flotation device having a top surface and a bottom surface,

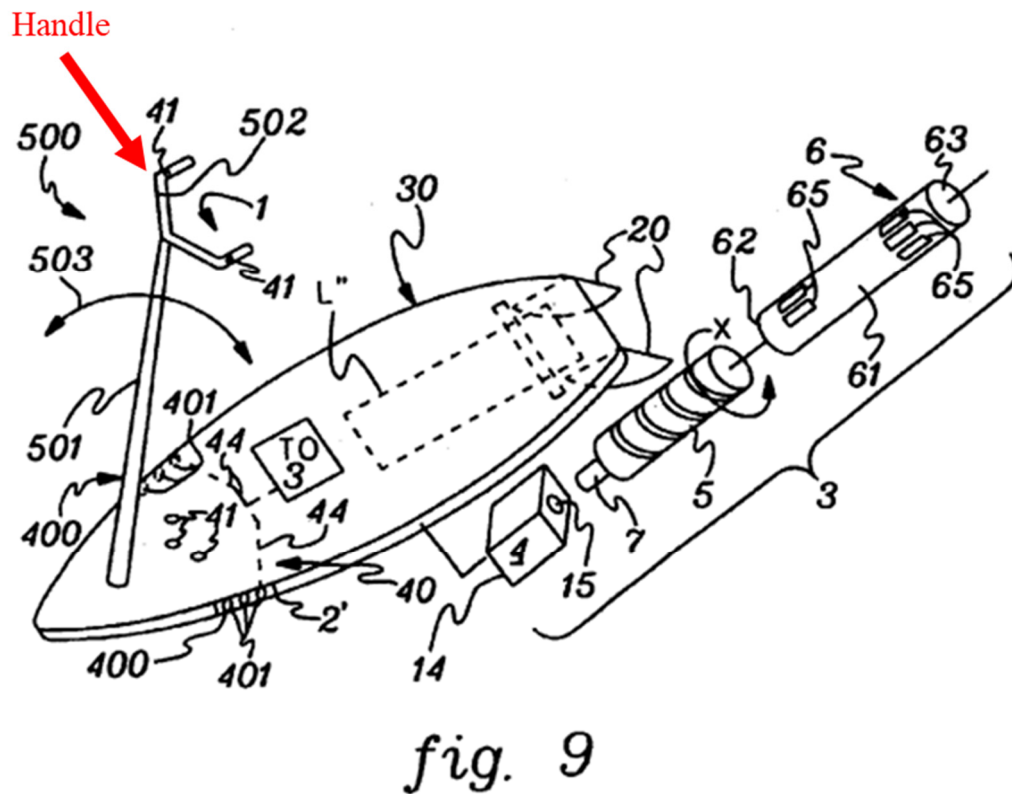
74. As discussed previously in ¶¶56-60 with regard to limitation [1A1], EvoloReport discloses a flotation device (“floating body”) that has a fore-aft length greater than a lateral width, the flotation device having a top surface and a bottom surface.

75. The EvoloReport flotation device is also shaped like a surfboard. As a first example, the floating body shown below is in the shape of a surfboard with two additions: a handle and a raised nose portion:

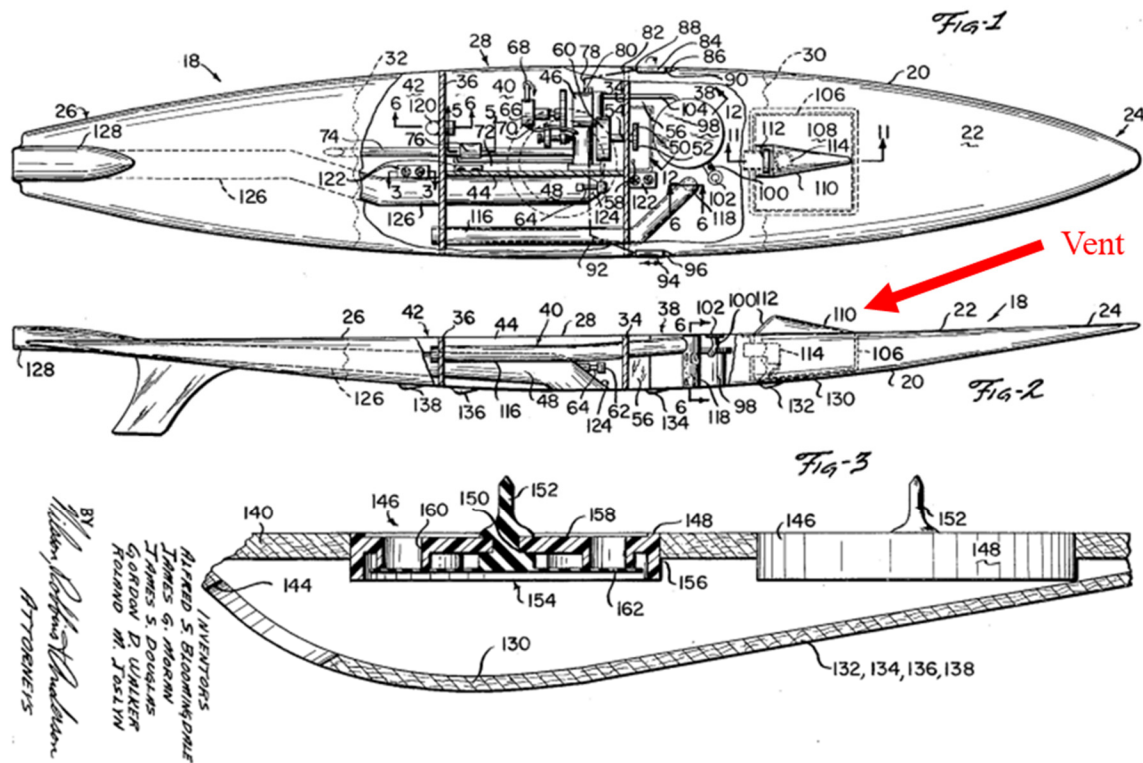


Ex-1003-EvoloReport at 3, FIG. 1. A POSITA would have recognized from the image above that a user could stand on top surface aft of the handle, just like on a surfboard.

76. The '659 patent uses the term “surfboard” to refer to prior art floatation devices that have similar shapes and configurations. For example, many of the prior art surfboards referenced by the 59 patent include additional handles and protrusions on the upper surface—just like the floatation body in the EvoloReport final design. Below are a few such examples:

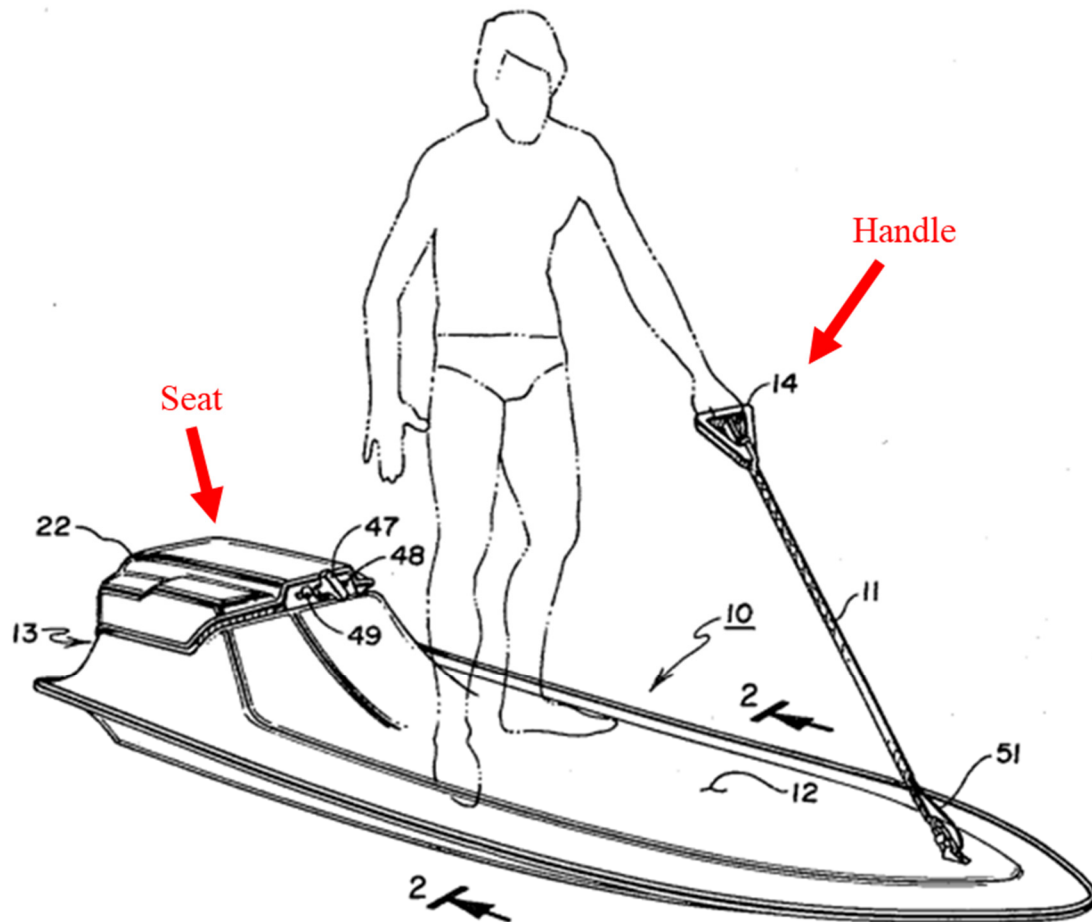


Ex-1029-Jung, FIG. 9; Ex-1001-USP659 at 1:32-35 (“Powered surfboards have been developed...as personal watercraft (U.S. Pat. No. 6,702,634 B2 Jung...).”).



Ex-1030-Bloomingtondale, FIG. 1; Ex-1001-USP659 at 1:32-35 (“Powered surfboards have been developed...as personal watercraft (...U.S. Pat. No. 3,262,413 A

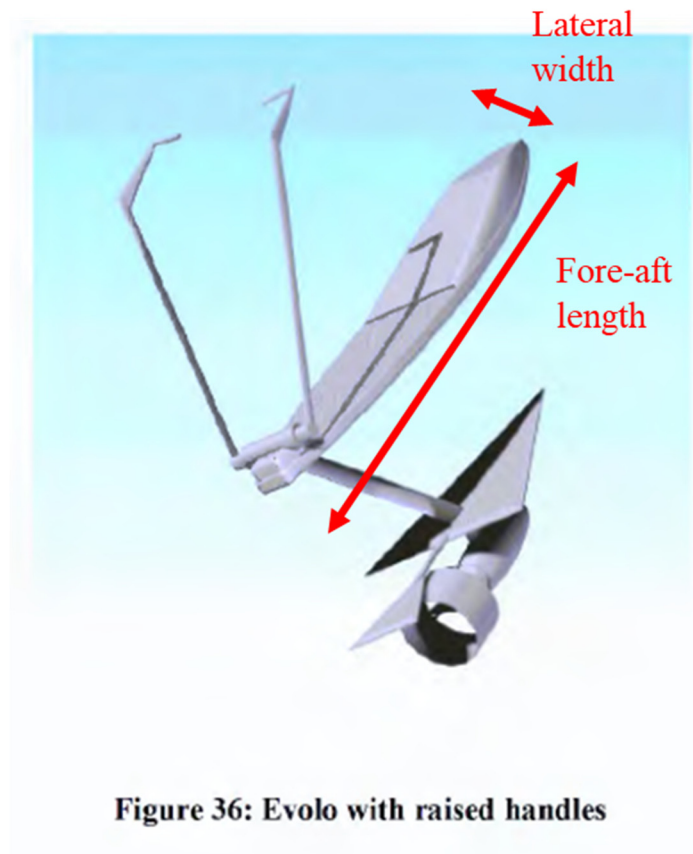
Bloomingtondale

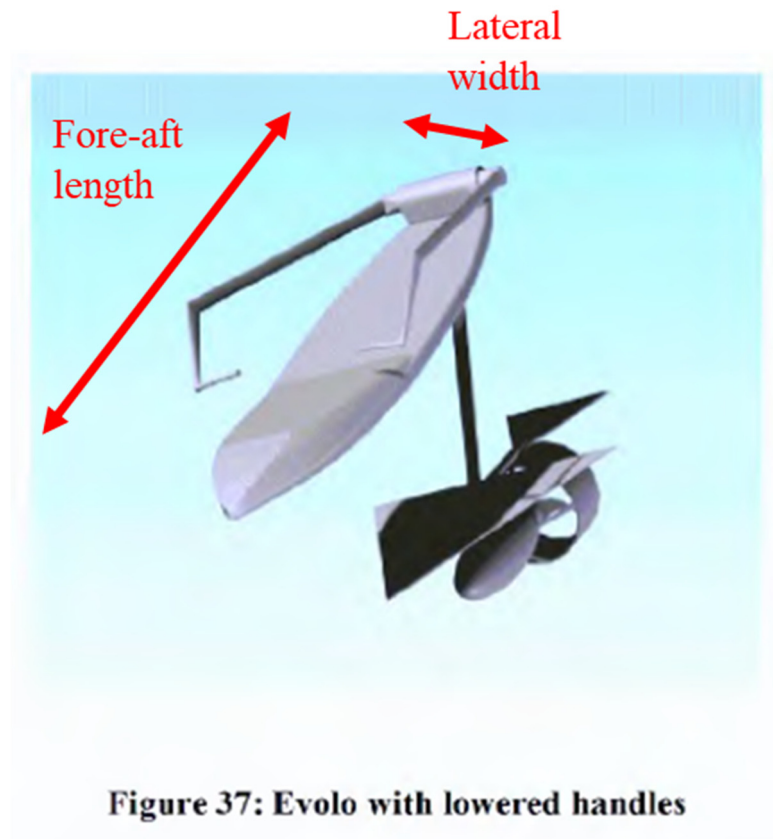


Ex-1031-Dawson, FIG. 1; Ex-1001-USP659 at 1:32-35 (“Powered surfboards have been developed...as personal watercraft (...U.S. Pat. No. 4,274,357 A Dawson...).”).

77. In addition, EvoloReport also discloses using other surf-board shaped floatation devices that do not have additional handles or protrusions on the upper surface. These all have a fore-aft length greater than a lateral width. Ex-1003-

EvolReport at 44 (“So far, the conclusion is that the **surfboard shape** pointed out in the report conceptual design can be used.”), 331 (“According to the requirements specification, the craft must be able to float and balance in a stationary position with the driver and be able to be steered by means of a center of gravity shift. Surveys regarding the target group show that close contact with the water and physical exertion are among the general features that water sports practitioners appreciate. A floating body in the form of a surfboard is easy to associate with these properties and **the shape of Evolo’s floating body has therefore been chosen to resemble a surfboard.**”). This is shown in Figures 36 and 37 below.





Ex-1003-EvoloReport at 332-333; *see also id.*, 539 (“Evolos is equipped with a **shortboard-like surfboard** (see figure 1). The board is adapted for the intermediate to advanced **surfer**. The size is determined so that the craft will not be too large and clumsy, nor too small so that it becomes difficult to balance, especially in the case of a hydrofoil. The drift nose is pointed for good maneuvering and hydrodynamics and it is angled upwards so as not to cut into the waves below the surface of the water. To be able to steer in the desired way, the driver has the option to **stand or sit** and lean in the desired direction.”), 401 (“Floating body of foam-filled polyester plastic, (old surfboard)”), 410 (same), 419 (“However, a new configuration was used on the Evolo. Instead of the previous

floating body, this time the front part from an old surfboard with a length of about

2 m and a width of 0.7 m was used.”), 424 (“The same test rig was used as in

experiment X8 [1], i.e. a surfboard as a floating body as this floating body was

considered to make the Evolo significantly easier to control.”), 538-539

(“According to the requirements specification, the craft must be able to float and

balance in a stationary position with the driver and be able to be steered by means

of a center of gravity shift. Previous research has shown that close contact with the

water and physical effort are among the general traits that make the craft successful

among the target group of similar watercraft. Craft in the form of a **surfboard**

seems to be able to fulfill many of these requirements. In simple terms, **surfboards**

can be divided into four different types based on their shape and size[]: •

Longboards (Malibu) • Fish • Funboards • Shortboards”).



Figure 1. Shortboard²

Ex-1003-EvoloReport at 539, FIG. 1.



Figure 1. Evolo before attempt 4

Id. at 419, FIG. 1.



Figure 42. Test rig for experiment 5.

Id. 424, FIG. 42.

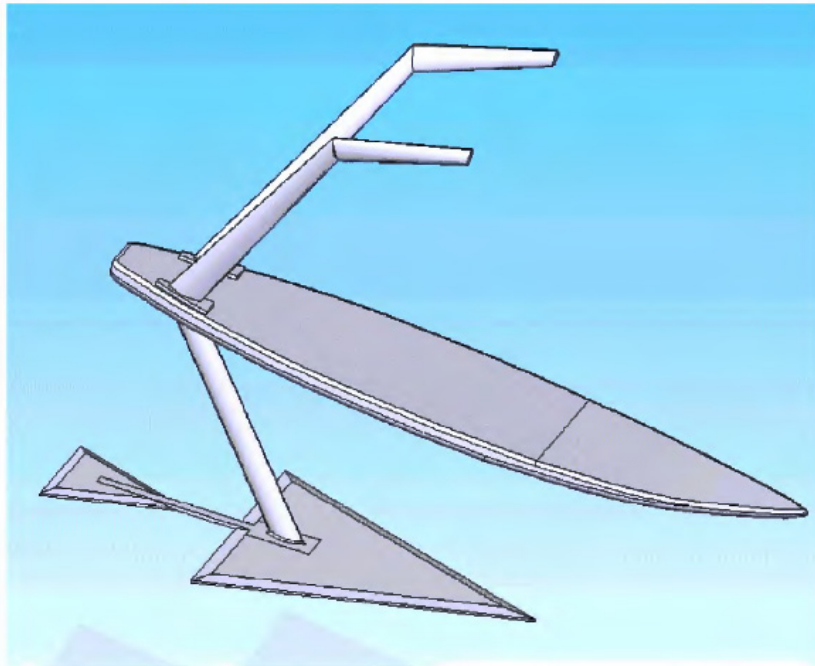


Figure 52. Evolo equipped with hydrofoil and handle

Id. at 540, FIG. 52.

78. In addition to the Evolo final design, A POSITA would have also been motivated to use one of these alternative surfboard-shaped floatation devices in a hydrofoil watercraft based on EvoloReport's express teaching to use such a shortboard-like form factor or other surfboards as a floatation device in a hydrofoil watercraft. Ex-1003-EvoloReport at 44, 50, 331, 401, 404, 410, 419, 424, 523, 530, 538, 539.

79. EvoloReport lists numerous reasons, including benefits, to using a surfboard shape. These include familiarity to surfers, manageable size, hydrodynamics, and easy steerability in a standing position. *Id.* at 539 (“**The board is adapted for the intermediate to advanced surfer.** The size is determined so that the craft will not be too large and clumsy, nor too small so that it becomes difficult to balance, especially in the case of a hydrofoil. The drift nose is pointed for good maneuvering and hydrodynamics and it is angled upwards so as not to cut into the waves below the surface of the water. To be able to steer in the desired way, the driver has the option to **stand or sit and lean in the desired direction.**”), 331 (“According to the requirements specification, the craft must be able to float and balance in a stationary position with the driver and be able to be steered by means of a center of gravity shift. Surveys regarding the target group show that close contact with the water and physical exertion are among the general features that water sports practitioners appreciate. A floating body **in the form of a surfboard** is

easy to associate with these properties and the shape of Evolo's floating body has therefore been chosen to resemble a surfboard.”).

80. A POSITA would have recognized additional benefits. For example, flotation device designs which do not have handles or protrusions on their upper surfaces would be easier to manufacture and take up less space. This would have been nothing new, since powered hydrofoil watercrafts with surfboard-shaped flotation devices had already been known for more than a decade. *See, e.g.,* Ex-1032-Chen, Abstract, FIGs. 1-7.

81. POSITAs routinely made decisions as to the final form factor of a watercraft product. The above considerations would have given a POSITA plenty of criteria to consider. Weighing these considerations, a POSITA would have found it obvious to use one of the alternative Evolo designs that lack protrusions or handles, over the final Evolo design.

82. A POSITA would have had a reasonable expectation of success in using one of these alternative floating body designs. For example, surfboard-shaped flotation devices were successfully tested during the Evolo design process, which made the watercraft easier to control. Ex-1003-EvoloReport at 424 (“The same test rig was used as in experiment X8 [1], i.e. **a surfboard as a floating body** as this floating body was considered to make the Evolo **significantly easier to control.**”), 419 (“However, a new configuration was used on the Evolo. Instead of the previous

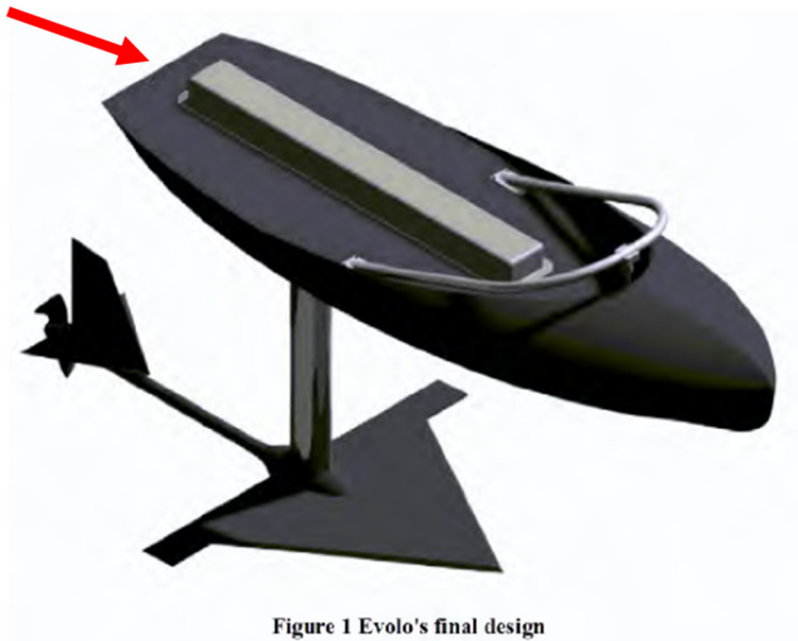
floating body, this time the front part from an old surfboard with a length of about 2 m and a width of 0.7 m was used.”). A POSITA could have retained the same connections with the strut and motor while simply swapping out the desired floating body.

(c) [16A2] wherein the top surface has a substantially horizontal supporting surface configured to support a user in a prone, kneeling, or standing position.

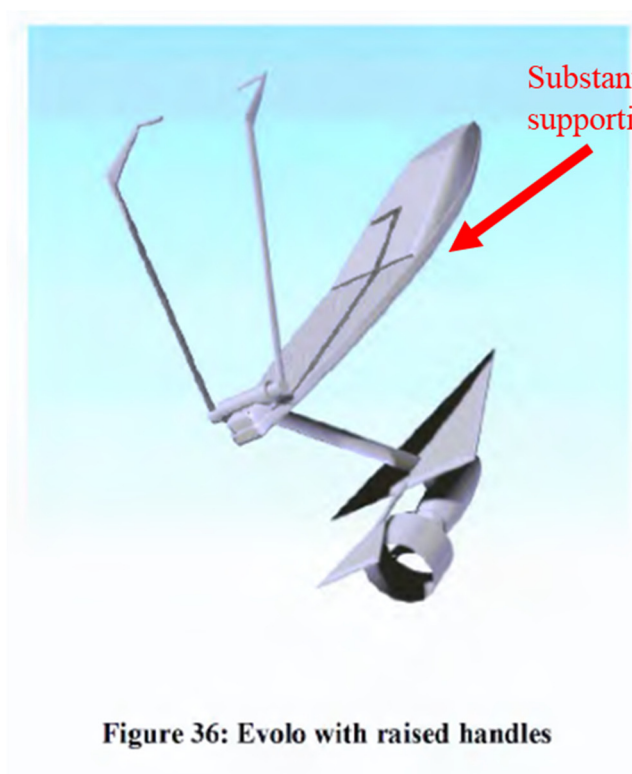
83. EvoloReport discloses a surfboard-shaped flotation device wherein the top surface has a substantially horizontal supporting surface. Ex-1003-EvoloReport at 3 (Figure 1 Evolo’s final design), 4 (Figure 2 General arrangement of Evolo). As discussed previously in ¶61 with reference to limitation [1A2], EvoloReport discloses a watercraft that is designed for use with a “kneeling driver’s position” holding the handles on the top surface of the flotation device. Ex- 1003-EvoloReport at 551.

84. The images below show that the floating bodies discussed with reference to limitation [1A1] have substantially horizontal supporting surfaces that can be used in a prone, kneeling, or standing position.

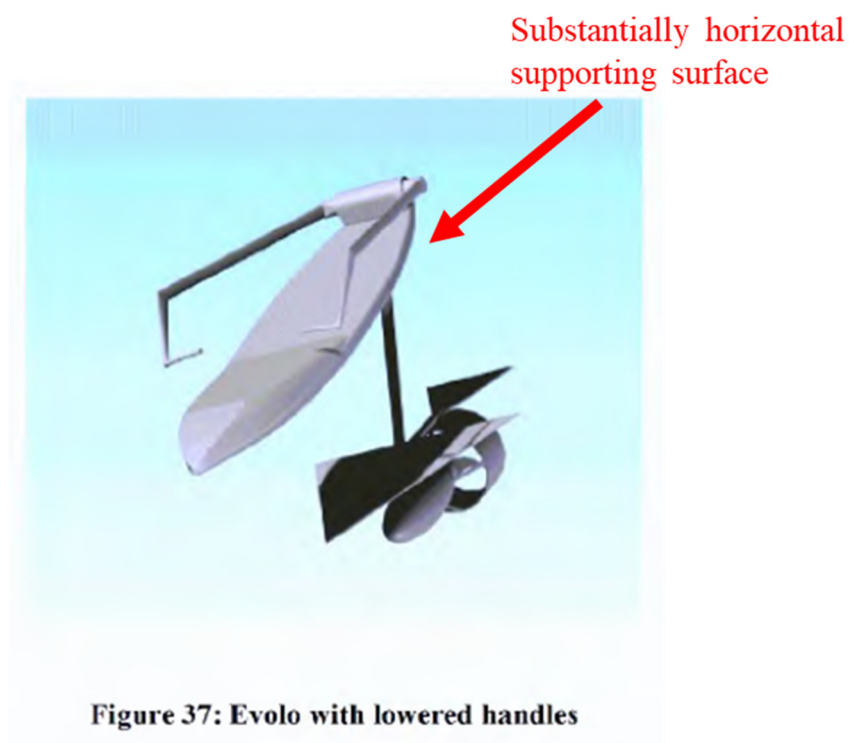
Substantially horizontal
supporting surface



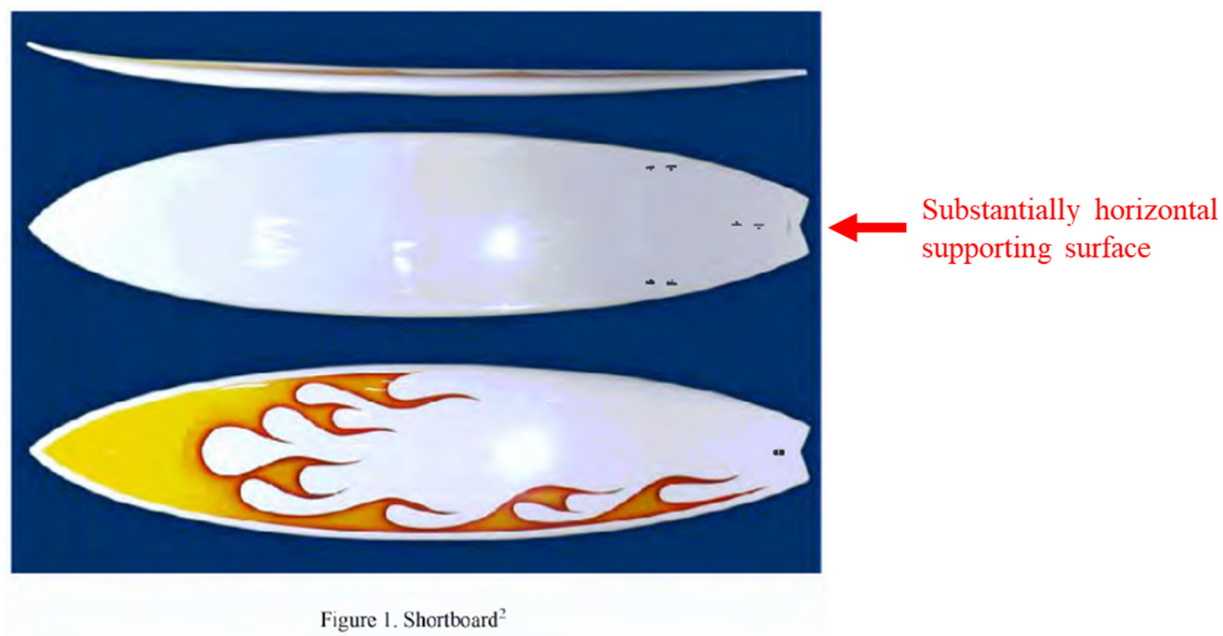
Ex-1003-EvoloReport at 3, FIG. 1.



Id. at 332, FIG. 36.



Id. at 333, FIG. 37.



Id. at 539, FIG. 1.



Figure 1. Evolo before attempt 4

Id. at 419, FIG. 1.



Figure 42. Test rig for experiment 5.

Id. at 424, FIG. 42.

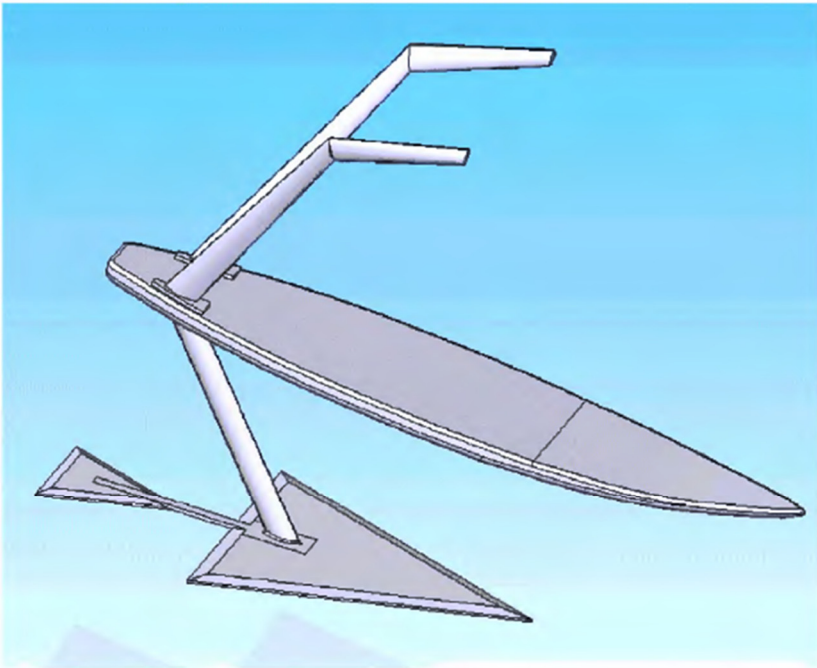
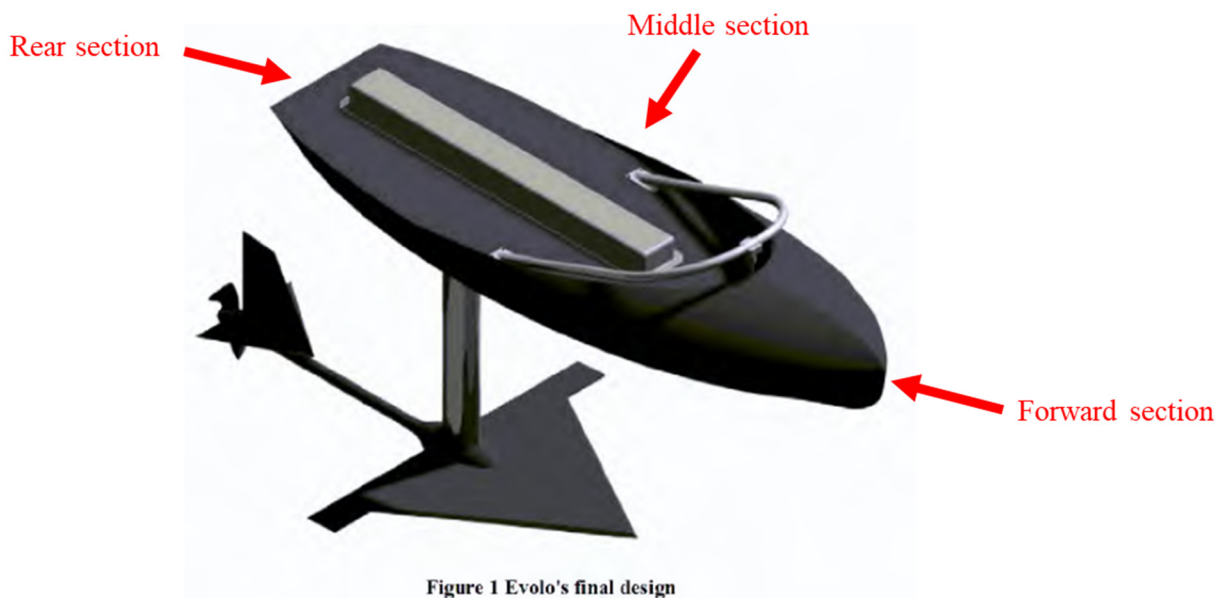


Figure 52. Evolo equipped with hydrofoil and handle

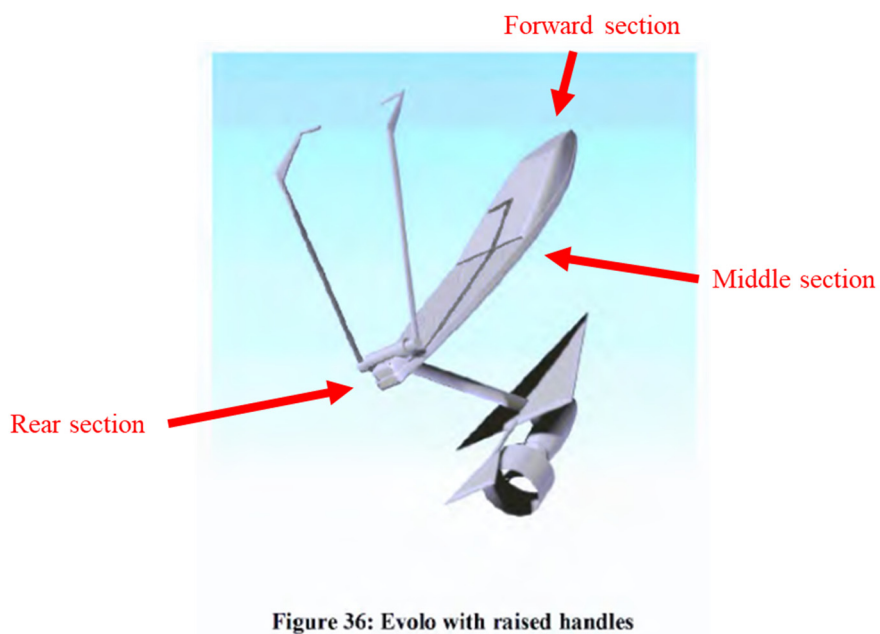
Id. at 540, FIG. 52.

- (d) [16A3] the flotation device having a forward section, a middle section, and a rear section;

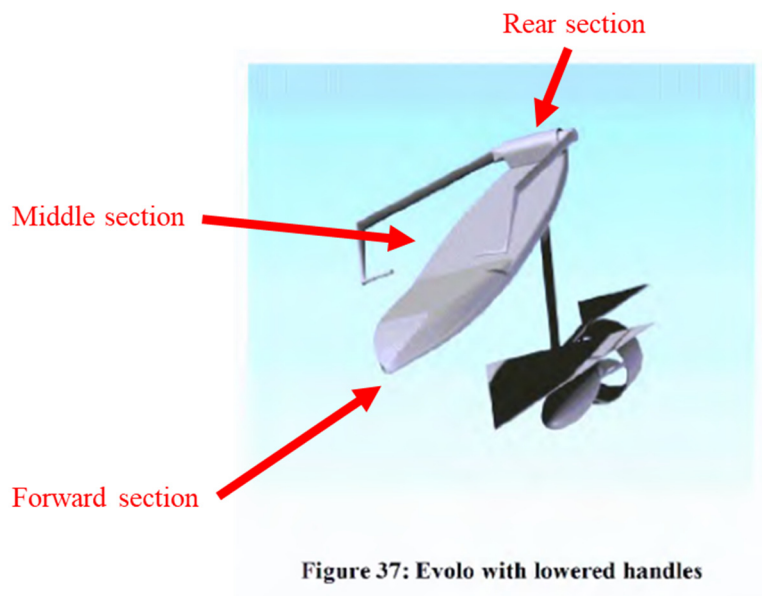
85. As discussed previously in ¶¶62-63 with reference to limitation [1A3], EvoloReport discloses a flotation device that has a forward section, a middle section, and a rear section. The forward, middle, and rear sections can also be seen in the flotation devices in the images below that lack handles and/or protrusions, which I discussed previously with reference to limitation [1A1].



Ex-1003-EvoloReport at 3, FIG. 1.



Ex-1003-EvoloReport at 332, FIG. 36.



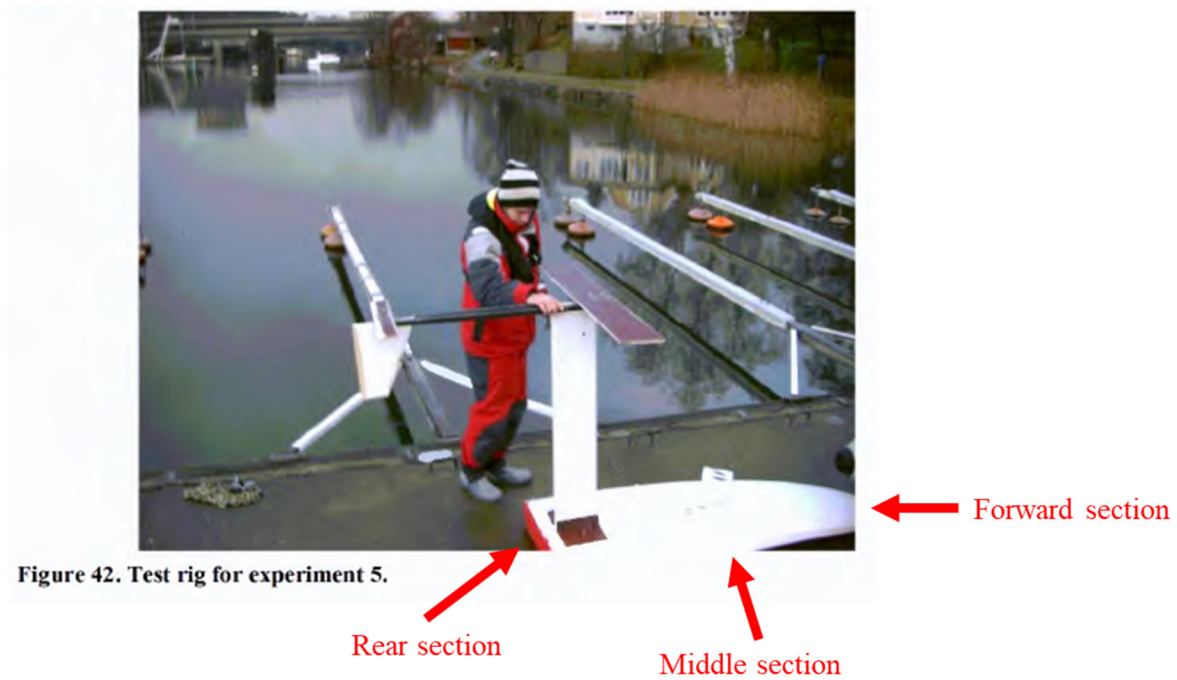
Id. at 333, FIG. 37.



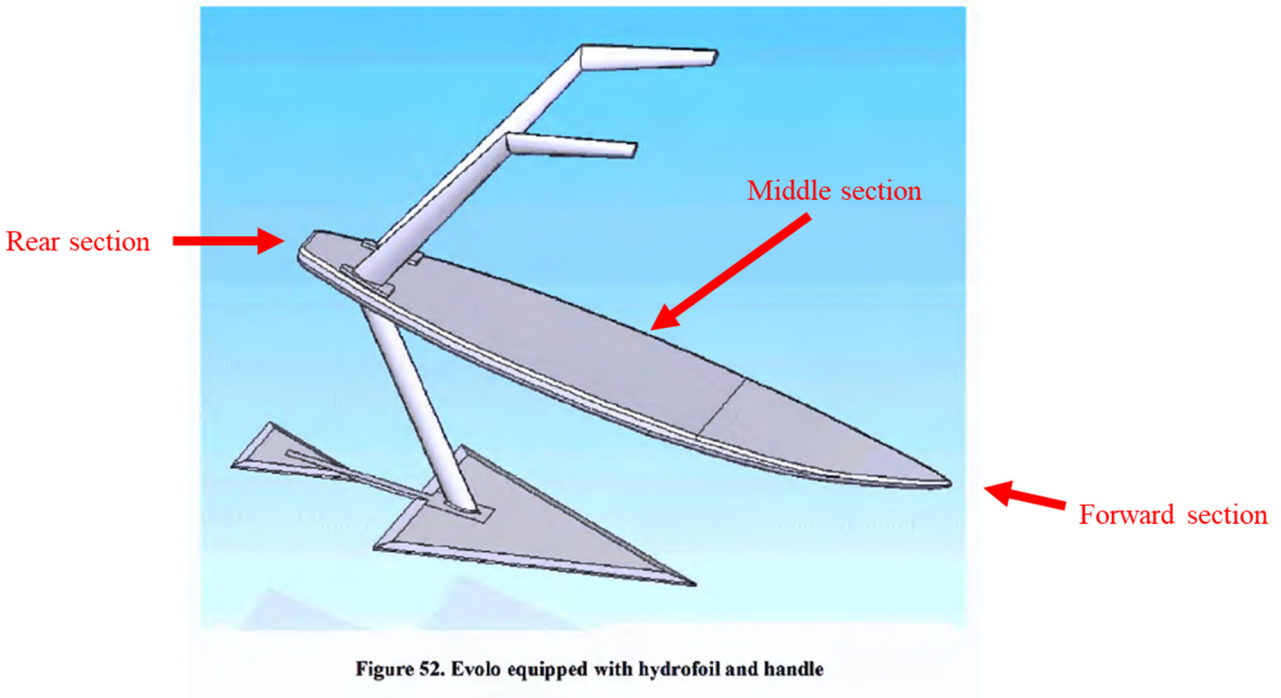
Id. at 539, FIG. 1.



Id. at 419. FIG. 1.



Id. at 424, FIG. 42.

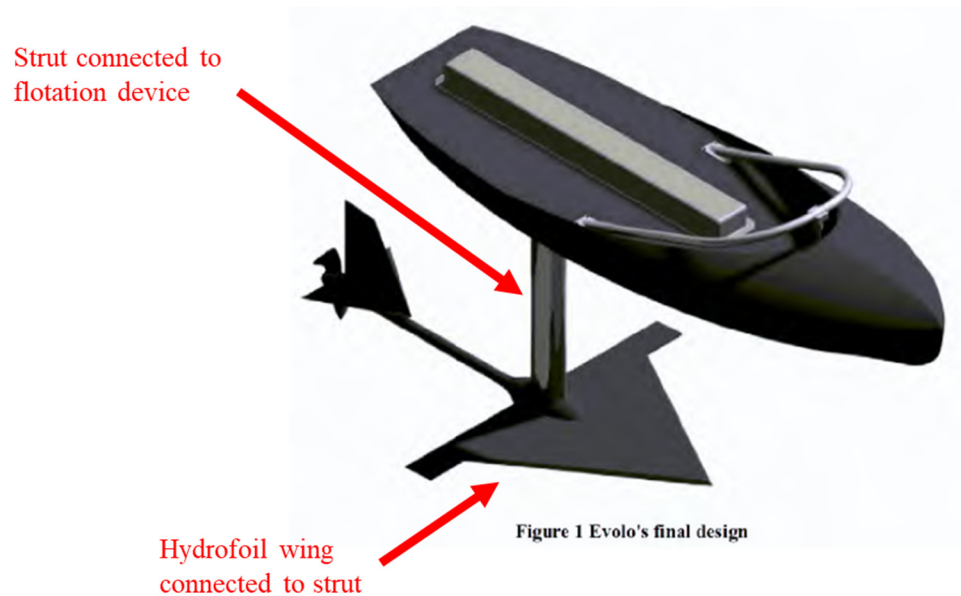


Id. at 540, FIG. 52.

- (e) [16B] a hydrofoil interconnected with the surfboard-shaped flotation device, the hydrofoil having a strut and a first hydrofoil wing, an upper end of the strut being fixedly interconnected with the surfboard-shaped flotation device, the hydrofoil having no movable surface;

86. EvoloReport discloses a hydrofoil interconnected with a surfboard-shaped flotation device. For example, as discussed previously in ¶¶64-70 with reference to limitations [1B] and [1C], EvoloReport discloses a strut having an upper end fixedly interconnected with the flotation device between the middle section and the rear section of the flotation device and a hydrofoil (e.g., hydrofoil wing) fixedly interconnected with the lower end of the strut. See Ex-1003-EvoloReport at 3 (Figure 1 Evolo's final design showing hydrofoil wing and strut interconnected to the

flotation device), 332 (Figure 36 Evolo with raised handles showing hydrofoil wing and strut interconnected to the flotation device), 333 (Figure 37 Evolo with lowered handles showing hydrofoil wing and strut interconnected to the flotation device), 540 (Figure 52 Evolo equipped with hydrofoil and handle showing hydrofoil wing and strut interconnected to the flotation device),



Ex-1003-EvoloReport at 3, FIG. 1.

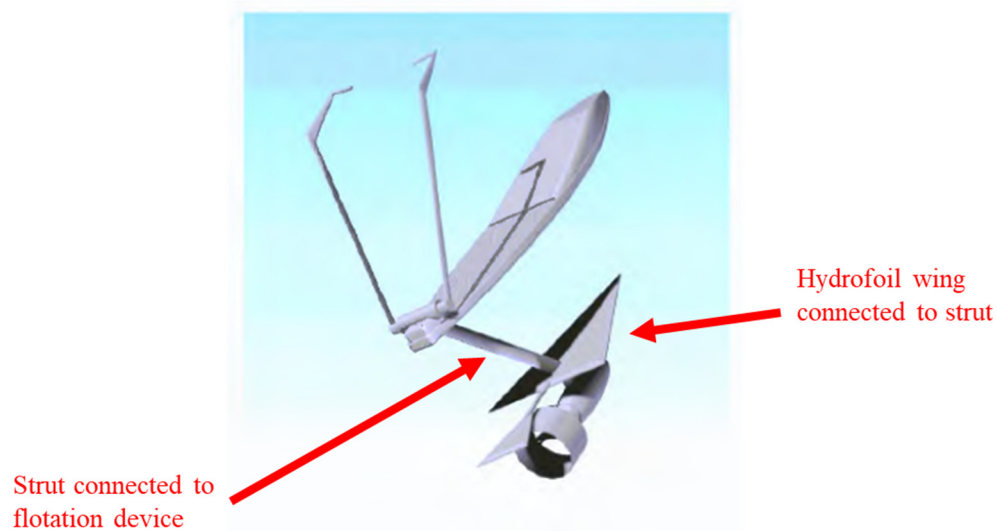


Figure 36: Evolo with raised handles

Id. at 332, FIG. 56.

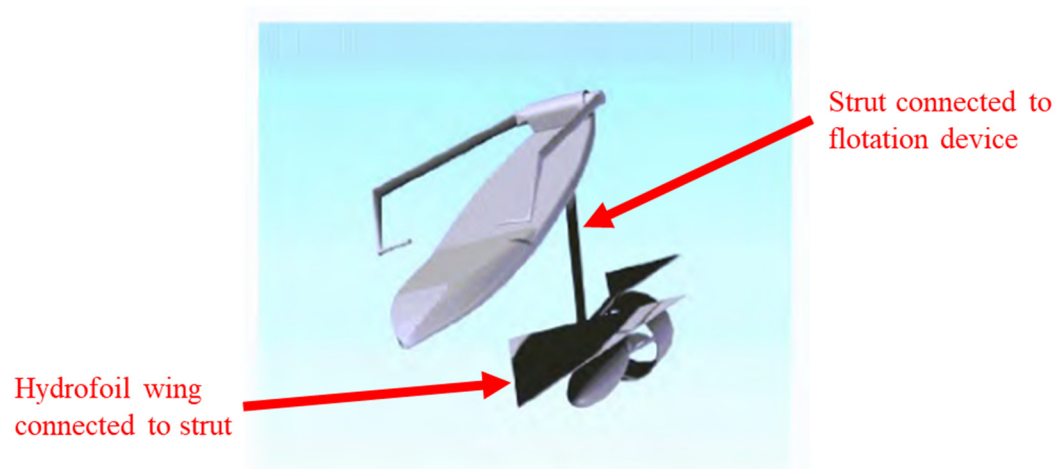
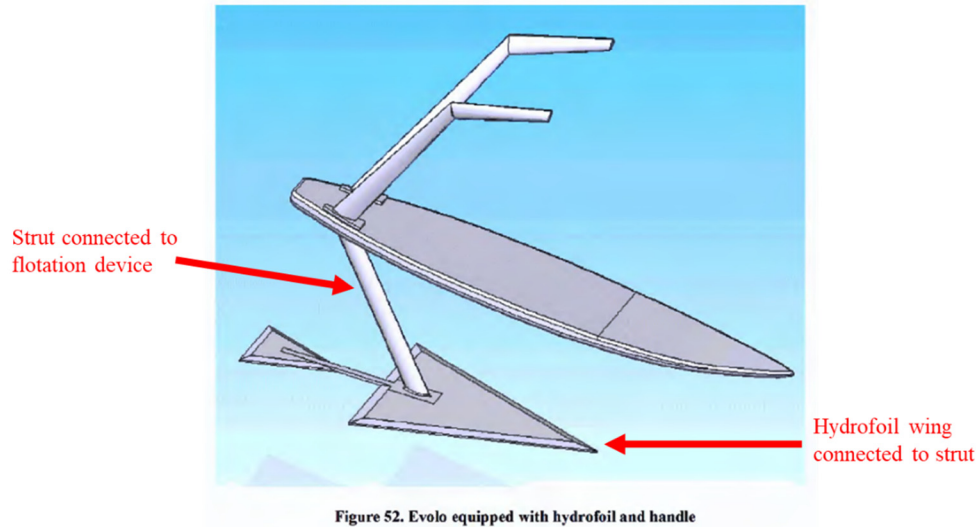


Figure 37: Evolo with lowered handles

Id. at 333, FIG. 37.



Id. at 540, FIG. 52; *see also id.* at 7 (“The strut is the part that connects the floating body and the hydrofoil. ...“only the carbon fiber cover layer is seen as supporting [the floating body and the hydrofoil].....”), 211-214 (discussing connection of strut to wing), 276 (“The longer bolts join the base plate [of the strut] with the floating body and are slightly shorter than the thickness of the floating body, which allows nuts to be set into the floating body.”), 227 (“The mounting of the aft hydrofoil in the strut between the hydrofoils will need to connect from a panel (wing) to a strut lying in the same plane, see figure 1. This means that a **fixed mounting** similar to that of Figure 1 with some changes is preferred. This is illustrated in Figure 6, where a cover layer is laid over the entire mounting to the strut. This will also need to be oversized to withstand torque loads.”). The hydrofoils used with form factors that lack handles and/or protrusions are therefore also interconnected with the

corresponding surfboard-shaped flotation devices—just like in the Evolo final design.

87. As discussed previously in ¶72 with reference to limitation [1E], the hydrofoil wings used in Evolo lack any moveable parts. In addition, the strut is a solid “carbon fiber cover layer” fixed to the hydrofoil wing and the floatation device, and therefore lacks moveable parts as well. Ex-1003-EvoloReport at 7. Thus, the hydrofoil, which includes the hydrofoil wing and strut—has no movable surface.

(f) [16C1] a propulsion system attached to the surfboard-shaped flotation device for propelling the watercraft in a body of water,

88. As discussed previously in ¶71 with reference to limitation [1D], EvoloReport discloses a propulsion system for propelling the watercraft in a body of water. As discussed previously in ¶86, the propulsion system is connected to the hydrofoil and the hydrofoil is fixed to the surfboard-shaped floatation device. Thus, the propulsion system of EvoloReport is attached to the surfboard-shaped floatation device by way of the hydrofoil.

(g) [16C2] the propulsion system comprising a battery, an electric motor, a motor speed controller, and a propulsor, wherein the propulsor is selected from a propeller, a ducted propeller, or a pump-jet,

89. EvoloReport discloses a watercraft having a propulsion system comprising a battery, an electric motor, a motor speed controller, and a propulsor, the propulsor selected from a propeller, a ducted propeller, or a pump-jet. Ex-1003-

Evoloreport at 9 (in order to power the chosen “*electric motor, new batteries were purchased for the project*”); *id.* (“In order to have an advantageous propulsion system for Evolo ... a standard propeller [can be] used or a propeller... is manufactured”); Ex-1003-Evoloreport at 498 (“The motor is controlled by varying the frequency of the input voltage by varying a control voltage to a control system ... indicates which speed or torque is desired...”).

90. The final design in Evoloreport uses the Torqeedo 4.0 R, an electric motor, to rotate a propeller to propel the watercraft through the water. Ex-1003-Evoloreport at 498 (“[A]n asynchronous motor that is now being investigated in the project, Torqeedo Cruise 2.0.”).

91. Evolo-Report discloses using the Torqeedo 2.0 R and the Torqeedo 4.0 R at different design stages due to the availability of the 4.0 R motor; however, both Torqeedo motors are electric motors. Ex-1003-Evoloreport at 498 (“Since most industrial and marine motors on the market, eg Torqeedo, are asynchronous motors...”). The watercraft further includes a motor speed controller (e.g., either an inverter or pulse modeler) that controls the speed of the motor. Ex-1003-Evoloreport at 498 (“The motor is **controlled by varying the frequency of the input voltage by varying a control voltage to a control system, a so-called inverter or pulse modeler...**”).

92. The EvoloReport discloses that the electric motor is powered by batteries. Ex- 1003-EvoloReport at 9 (“In order to be able to use the selected electric motor, **new batteries** were purchased for the project.”). The electric motor provides rotation to a propeller that drives the watercraft through the water. Ex-1003-EvoloReport at 9 (“The **finished propeller** is shown in Figure 9.”).

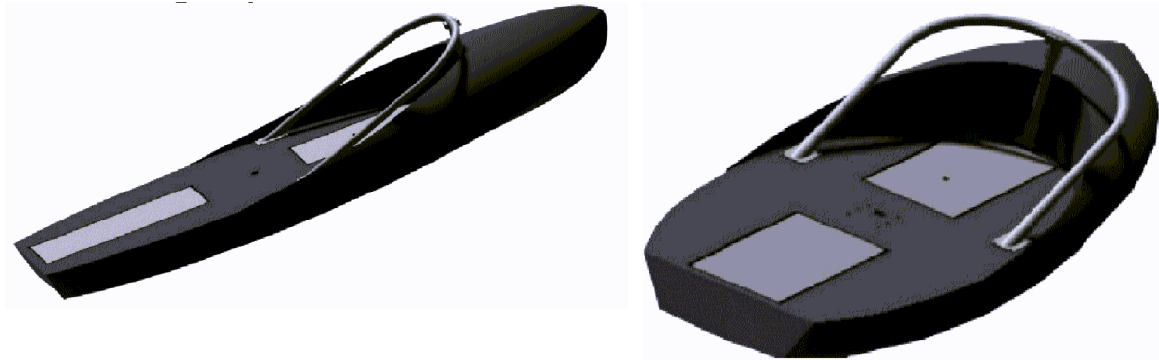


Figure 9 Propeller manufactured for Evolo

Ex-1003-EvoloReport at 9, FIG. 9.

- (h) [16C3] and the battery and motor speed controller are contained in a watertight compartment integrated into the flotation device;

93. EvoloReport discloses a watercraft having a watertight compartment integrated into the flotation device. The watertight compartment of EvoloReport is shown by the grey plates in the below Figures 11 and 12. Ex-1003-EvoloReport at 550, 327 (“[T]his throttle control should be placed **inside the waterproof battery container** that encloses the top of the mounting of the strut.... This is the critical point of the cable routing due to the fact that **the battery container must be waterproof.**”).



Ex-1003-EvoloReport at 550. These watertight compartments house the batteries.

Ex-1003-EvoloReport at 550 (“The floating body has sufficient volume to be able to stay afloat with the driver. **It should also have room for batteries.**”).

94. EvoloReport further discloses including additional electronics (i.e., the throttle, lanterns, and a display screen) in the watertight battery compartment. Ex-1003-EvoloReport at 327 (“[T]his throttle control should be placed **inside the waterproof battery container** that encloses the top of the mounting of the strut.”); Ex-1003- EvoloReport at 524 (“A slightly larger volume is also required for other reasons **such as containing batteries and electronics**. The vision is that **this volume should also be able to contain a waterproof storage compartment, a clear LCD screen with information about speed, battery level, depth, position, etc., and lanterns.**”).

95. Although EvoloReport discusses incorporating both the throttle and batteries into the watertight compartment, EvoloReport specifically chooses to use

a Torqeedo motor largely because the Torqeedo was already available and was provided with all the required components in a preassembled package. Ex-1003-EvoloReport at 180 (“The motor available today is a Torqeedo Cruise 2.0R....The **advantages of this system are that it is a complete driveline. Control systems are available and can be modified to work on Evolo.**”); Ex-1003-EvoloReport at 491 (“There are several options on the market today in terms of **ready-made electric motor concepts** for marine use. The method would be to source a product... then **remove the excess parts to build the motor and electrical system into the Evolo’s design.**”).

96. EvoloReport does not specifically disclose whether the motor speed controller is contained within the watertight motor pod or within the watertight battery container as EvoloReport drafters purposely chose the already completed Torqeedo motor unit. Ex-1003-EvoloReport at 8 (“[The throttle] is designed like a bicycle brake, see Appendices 20 and 44, and **its wiring is passed through the strut down to the motor and its control unit.**”); Ex-1003-EvoloReport at 181 (“When it comes to controlling the motors, there is no major difference as **Torqeedo’s options include complete systems** and VIAB’s **only need some form of potentiometer to regulate the current.**”); Ex-1003-EvoloReport at 498 (“Since **most industrial and marine motors on the market, eg Torqeedo, are asynchronous motors**, there is a need to summarize their function and control... Since the motor control of

asynchronous motors is of a control technology type and that the skills required to manufacture an own system are not available in the project today, **it is strongly recommended to purchase an already completed system**, adapted to the motor that is finally chosen for Evolo.... **Due to the complexity of motor control of asynchronous motors, it is strongly recommended to use the motor manufacturer's own control system.**”).

97. EvoloReport discloses obtaining alternative engine systems and that a control unit would need to be obtained and connected with the chosen motor. Ex-1003-EvoloReport at 189-190 (“The purpose of this study is to make a benchmarking of what opportunities there are to develop your own motor solution instead of modifying an existing one and what consequences and opportunities it gives the project.... **Another challenge is that such an motor requires control. This is not built yourself.**”); Ex-1003-EvoloReport at 193-194 (“The company could also sell a control unit for about 350 dollars plus shipping.... **The advantage of these motors is that they are completely ready and ‘only’ to integrate and connect with a control unit.**”).

98. EvoloReport also discusses integrating a control unit (i.e., a potentiometer) near the handle mounted throttle control. Ex-1003-EvoloReport at 184 (“This has a great advantage in view of the fact that **the potentiometer, or control unit for the motor, can be placed separately from the handle** and that the

handle can then be moved more easily.... The cable to the potentiometer can be selected as a regular bicycle brake cable. **If the motor is a torquedo, the wiring to the motor bulb**, which is an ordinary telephone cable with connectors at the ends, can be easily spliced and extended, which **provides easy movement and separation of handles, control unit and motor.**"); Ex-1003-EvoloReport at 185-186 ("The components are easy to procure or manufacture and **allow a wide variety of final placement.** However, **the control itself should not be made too far** as it will then be pulled obliquely if you do not apply the throttle in the middle of the control.").

99. Further, EvoloReport states that the throttle control for the Torquedo motor, should logically be located in the waterproof battery container to ensure that the throttle control will always be dry. Ex-1003-EvoloReport at 327 ("Preliminarily, this **throttle control should be placed inside the waterproof battery container** that encloses the top of the mounting of the strut. This means that **the throttle control will always be dry and is currently the logical choice....** This is the critical point of the cable routing due to the fact **that the battery container must be waterproof** and the cable must be pulled in such a way that they do not destroy it."). EvoloReport thus teaches that it is important to keep sensitive electronics, such as the batteries and throttle controls, dry to prevent water damage.

100. Accordingly, a POSITA would have been motivated, based on EvoloReport's own teachings, to incorporate the motor speed controller into the

watertight compartment of the flotation device if a preassembled waterproof engine were not used.

(i) [16D] the watercraft having no movable steering system;

101. As discussed previously in ¶72 with reference to limitation [1E], EvoloReport discloses the watercraft having no movable steering system.

(j) [16E] a handheld controller having a throttle; and

102. EvoloReport discloses or renders obvious a handheld controller having a throttle. Ex-1003-EvoloReport at 524 (“The handles have controls for the engine and dead man’s switch. For even greater freedom, you should be able to remove the stays for the handles completely and disconnect the handles, **which can then regulate the motor wirelessly.**”) Although wireless control of the motor was not implemented in the final design of EvoloReport, it was clearly contemplated in the early design stages of the project. Therefore, the authors of EvoloReport, who contain less skill than a POSITA, were motivated to incorporate a wirelessly controlled motor.

103. A POSITA would have had the knowledge and experience to incorporate a wirelessly controlled motor via a handheld controller with a throttle. In doing so, a POSITA would have implemented a handheld transmitter with a throttle and throttle interface receiver as this is the primary way to incorporate a wireless control device to operate an electric motor. Therefore, a POSITA would

have been motivated to modify the watercraft of Evolo to incorporate the wireless motor control that is discussed in Evolo-Report's conceptual design to yield predictable results (a wirelessly controlled watercraft). A POSITA would have a reasonable expectation of success given that remote control technology was well known at the time and incorporating a remote control is well within the skill of a POSITA.

- (k) [16F] a throttle interface, wherein the throttle is adapted to send electronic signals to the throttle interface that cause an output of the propulsion system to change.

104. As discussed previously in ¶¶102-103 with reference to [16E], EvoloReport discloses or renders obvious a wireless handheld controller with a throttle, and that such a controller would have been implemented in conjunction with a throttle interface that receives wireless control signals to control the motor. Therefore, the throttle would have been adapted to send electronic signals to the throttle interface that cause an output of the propulsion system to change.

105. This obvious implementation of a wireless controller is consistent with disclose by other skilled artisans, such as Manning. Manning had already implemented a powered surfboard with a wireless control with similar features, including transceivers/interfaces to send and receive signals from the wireless controller to control the output of a motor. Ex-1013-Manning at 4:66-5:7 (“For the preferred embodiment associated with a controller, such light modules comprise

wireless communication circuitry configured for communication with a controller.

For one embodiment, such communication capabilities include **a receiver configured to receive control signals** (such as a turn on/off signal) from the controller. For such an alternative embodiment, communication capabilities include a transmitter for transmitting data to a remote device such as the controller.”), 11:51-65 (“For one embodiment, relatively long range wireless communication circuitry includes RF transceiver (250) electrically associated with antenna (252). RF Transceiver (250) is configured to transmit and receive data signals to/from a remote electronic device. It should be noted that embodiments where such communication circuitry comprises only a transmitter or only a receiver fall within the scope of the invention. For one embodiment, transceiver (250) comprises a relatively low power transmitter that transmits a data signal in an unlicensed frequency band. Other embodiments include a relatively longer range transmitter comprising any number of well known technologies for wireless communications transmitting at any legal power level. For example, transceiver (250) may be configured to communicate over GPRS, GSM, GPRS, 3G, and EDGE enabled networks as well as WAP networks.”). This confirms a POSITA would have understood how and found it obvious to implement a wireless control system in Evolo with a throttle interface for receiving electronic signals to control the motor.

3. Claim 17: A watercraft in accordance with claim 16, wherein the hydrofoil comprises a plurality of

**hydrofoil wings including the first hydrofoil wing and
a second hydrofoil wing, the first and second
hydrofoil wings being connected by way of a strut.**

106. EvoloReport discloses a watercraft having a hydrofoil comprising a plurality of wings that are interconnected by way of a strut. Specifically, EvoloReport discloses a watercraft having a front hydrofoil and a rear (“aft”) hydrofoil that are connected by way of a carbon fiber strut (e.g. the stay). Ex-1003-EvoloReport at 7 (“As can be seen in Figure 6 below, it was chosen to integrate the motor in **the front hydrofoil** and that the propeller is placed **behind the aft hydrofoil**. The propeller shaft runs from the motor to the propeller **inside a carbon fiber stay**.”).

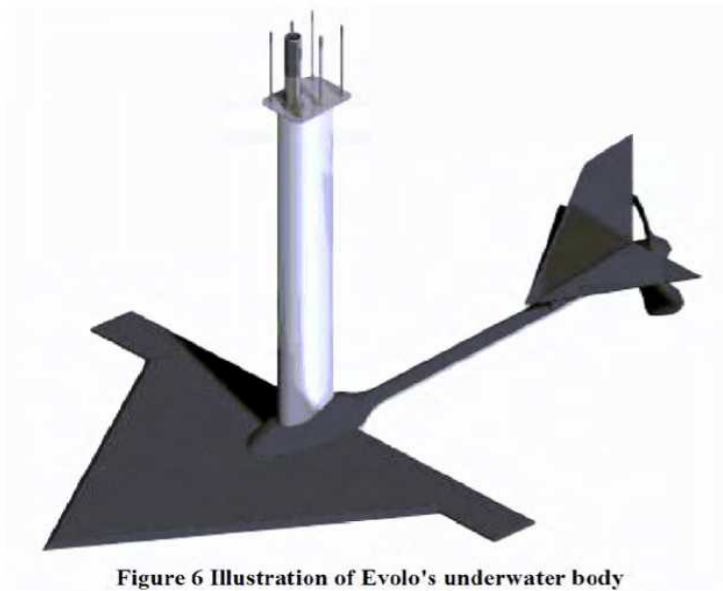


Figure 6 Illustration of Evolo's underwater body

As the front hydrofoil and the rear hydrofoil are connected via the motor pod and the rear strut, the front hydrofoil is interconnected to the rear hydrofoil by way of a strut.

107. Furthermore, Woolley discloses a hydrofoil comprised of two wings - its front blade and rear blade - interconnected by way of a strut.

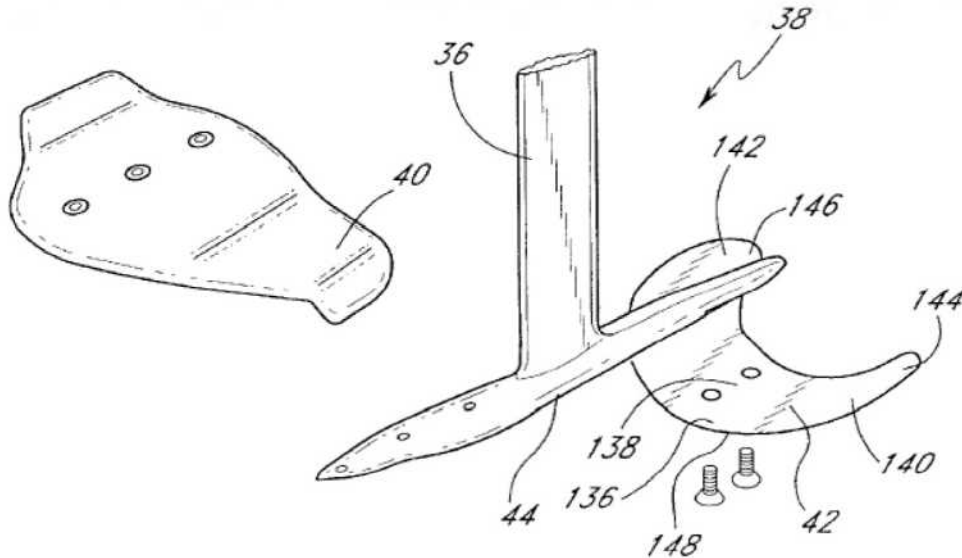


FIG. 7A

Ex-1011-Woolley at Fig 7A. Forward blade 40 and aft blade are interconnected via strut 44. Ex-1011-Woolley at 10:38-40 (“The planing blade or blade assembly 38 advantageously has a front blade 40 and a rear blade 42 interconnected by a fuselage 44.”).

108. Accordingly, POSITA would have found claim 17 rendered obvious by EvoloReport in light of Woolley.

4. Claim 18: A watercraft in accordance with claim 16, wherein the watercraft comprises a cooling system for cooling the electric motor.

109. EvoloReport discloses a watercraft having an electric motor integrated in a waterproof, streamlined pod. Ex-1003-EvoloReport Fig. 2 at.492 (below).



In EvoloReport, the structure of the Torqeedo motor is altered such that only the waterproof pod housing and vertical steel rod that houses the cables are retained from the stock image of the Torqeedo motor shown above. Ex-1003-EvoloReport at 491 (“There are several options on the market today in terms of **ready-made electric motor concepts for marine use**. The method would be to source a product... then **remove the excess parts to build the motor and electrical system into the Evolo’s design**.”). EvoloReport retains the waterproof, streamlined pod of the Torqeedo motor and removes the lower fin, propeller, and upper controls to allow the motor to be integrated into the motor pod mountings.

110. Additionally, the disclosed Torqeedo 4.0 R includes a cooling system. Ex-1003-EvoloReport at 257 (“...holes in the mold must be left around the center of the motor because **the cooling to the motor is there....**aluminum plates must be cast into the mold around **the motor’s cooling part**”) EvoloReport further discloses constructing a streamlined, watertight housing having a cooling system for the motor

in the event a completed marine motor was unavailable. Ex-1003-EvoloReport at 515 (“If an option not initially adapted to drive a propeller in water is chosen, **the motor must be built into some kind of watertight housing**. Construction of such must be verified, **both in terms of strength and resistance contribution to the craft** but **also in terms of function such as cooling** and that it holds tight.”) EvoloReport therefore discloses a watercraft having an electric motor that is integrated into a waterproof, streamlined pod and the watercraft comprises a cooling system for cooling the electric motor.

5. Claim 19: A watercraft in accordance with claim 16, wherein the strut has an internal passage and electrical wires extend from the electric motor to the watertight compartment inside the strut through the internal passage for controlling electric motor.

111. EvoloReport discloses that the strut contains an internal passage to allow electrical wires to extend from the electric motor to the waterproof compartment through the internal passage. Ex-1003-EvoloReport at 7 (“The rod bar **is part of the original motor structure** and is retained as it has a guaranteed waterproof link down to the motor bulb.”). The strut includes the hollow rod that links the electric motor to the battery compartment. Ex-1003-EvoloReport at 276 (“As the motor cannot be detached from the shaft, the profile and any other parts must be put on the shaft from above.”); *id.* (“In this figure, the motor represents the

square plate.”) (referring to Figure 2, below). This rod links the electric motor to the battery compartment.



Figure 2. Steel shaft from motor.

Ex-1003-EvoloReport at 276, FIG. 2.

112. The strut is then connected to the flotation device by bolting a base plate to the flotation device. Ex-1003-EvoloReport at 275 (“The existing motor construction consists of the motor unit which is linked to the steering by means of a 750 mm long steel shaft with an outer diameter of 35 mm, **through which shaft control cables and power cables run.**”); *Id.* at 276 (“**Note the hole for the cables at the aft towards the battery boxes [3],** as well as the threaded upper part of the shaft....The function of the base plate is to transmit the forces and torques absorbed by both the shaft and the profile to the floating body.”)

113. As shown in the image above, the rod contains a passage to allow for cables to be routed from the motor to the battery and controls to provide power and control signals to the motor. Ex-1003-EvoloReport at 276.

114. EvoloReport therefore discloses a watercraft having a strut with an internal passage and electrical wires extending from the electric motor to the

waterproof compartment inside the strut through the internal compartment for controlling the electric motor.

6. **Claim 20: A watercraft in accordance with claim 16, wherein the handheld controller comprises a wireless transmitter operatively coupled to the throttle and the throttle interface includes a receiver, the transmitter being adapted to send wireless signals to the receiver in response to actuation of the throttle that cause an output of the propulsion system to change.**

115. EvoloReport discloses or renders obvious a watercraft comprising a wireless handheld controller having a transmitter, and a throttle interface having a receiver, wherein the transmitter is adapted to send wireless signals to the receiver that cause an output of the propulsion system (motor) to change. Ex-1003-EvoloReport 524 (“The handles have controls for the engine and dead man’s switch. For even greater freedom, you should be able to remove the stays for the handles completely and disconnect the handles, **which can then regulate the motor wirelessly.**”).

116. Although wireless control of the motor was not implemented in the final design of Evolo-Report, it was clearly contemplated in the early design stages of the project. Therefore, it was obvious to the authors of EvoloReport, who contain less skill than a POSITA, were motivated to incorporate a wirelessly controlled motor.

117. A POSITA would have had the knowledge and experience to incorporate a wirelessly controlled motor via a handheld transmitter and throttle

interface receiver as this is the primary way to incorporate a wireless control device to operate an electric motor. Therefore, a POSITA would have been motivated to modify the watercraft of EvoloReport to incorporate the wireless motor control that is discussed in EvoloReport's conceptual design to yield predictable results (a wirelessly controlled watercraft). A POSITA would have a reasonable expectation of success given that remote control technology was well known at the time and incorporating a hand held remote control is well within the skill of a POSITA.

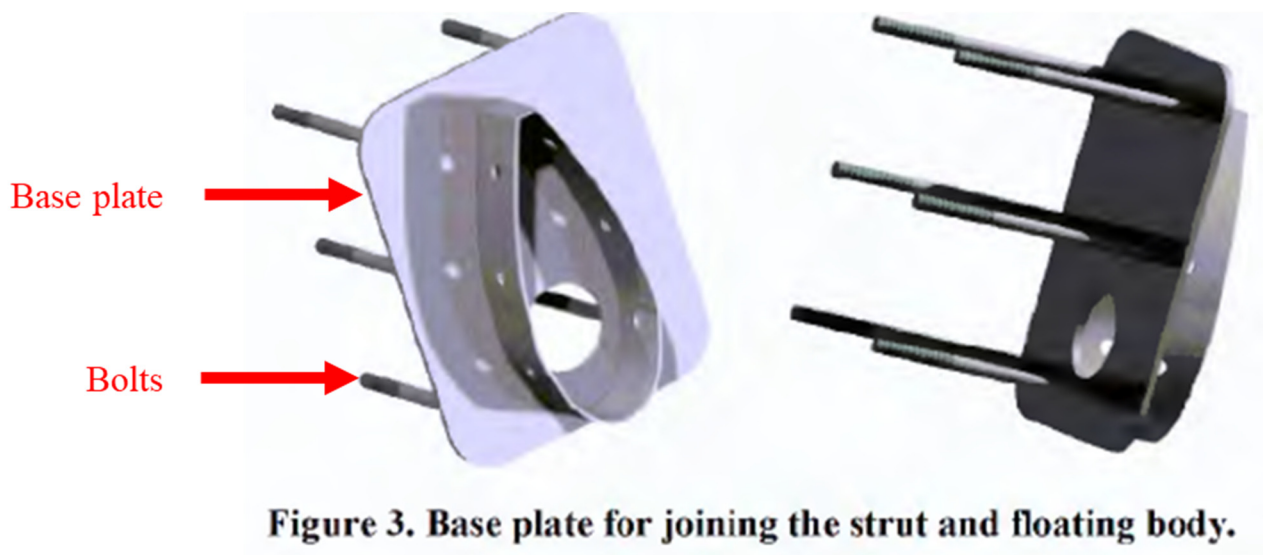
118. This obvious implementation of a wireless controller is consistent with disclose by other skilled artisans, such as Manning. Manning had already implemented a powered surfboard with a wireless control with similar features, including a wireless control system having a similar transmitter and receiver. Ex-1013-Manning at 4:66-5:7 (“For the preferred embodiment associated with a controller, such light modules comprise **wireless communication circuitry configured for communication with a controller**. For one embodiment, such communication capabilities include a **receiver configured to receive control signals** (such as a turn on/off signal) from the controller. For such an alternative embodiment, communication capabilities include a **transmitter for transmitting data to a remote device such as the controller.**”), 11:51-65 (“For one embodiment, relatively long range wireless communication circuitry includes **RF transceiver** (250) electrically associated with antenna (252). RF Transceiver (250) is configured

to transmit and receive data signals to/from a remote electronic device. It should be noted that embodiments where such communication circuitry comprises only a transmitter or only a receiver fall within the scope of the invention. For one embodiment, transceiver (250) comprises a relatively low power transmitter that transmits a data signal in an unlicensed frequency band. Other embodiments include a relatively longer range transmitter comprising any number of well known technologies for wireless communications transmitting at any legal power level. For example, transceiver (250) may be configured to communicate over GPRS, GSM, GPRS, 3G, and EDGE enabled networks as well as WAP networks.”). This confirms a POSITA would have understood how and found it obvious to implement a wireless control system in Evolo with a handheld controller that includes a wireless transmitter operatively coupled to the throttle and a throttle interface with a receiver, the transmitter being adapted to send wireless signals to the receiver in response to actuation of the throttle that cause an output of the propulsion system to change.

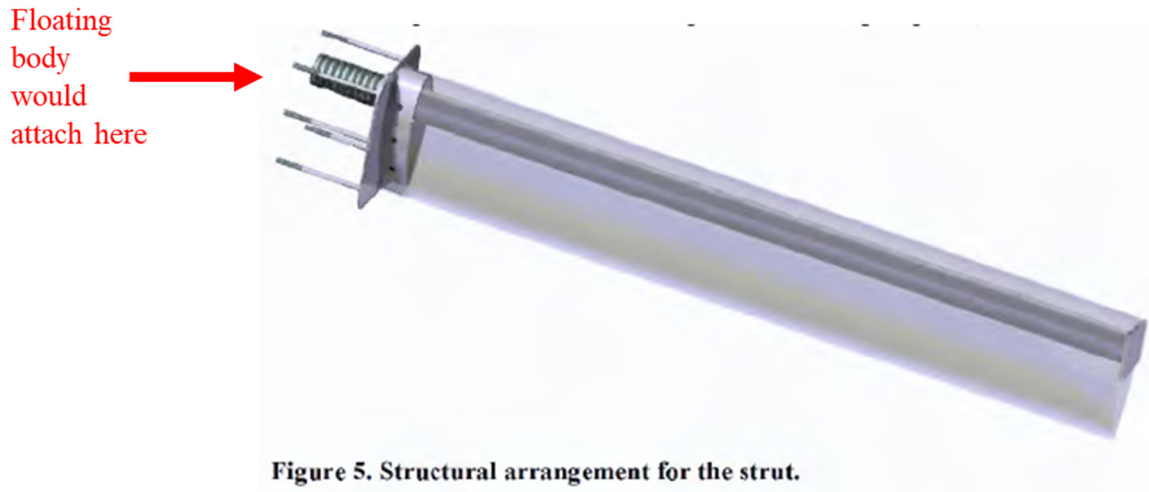
7. Claim 21: A watercraft in accordance with claim 1, wherein the upper end of the strut is fixedly interconnected with the flotation device via a detachable fitting.

119. EvoloReport discloses the upper end of the strut is fixedly interconnected with the flotation device via a detachable fitting. EvoloReport discloses that the end of the strut connecting the hydrofoil to the floating body is mounted to the floating body via a base plate (which is a fitting) secured with screws

or bolts. Ex-1003-EvoloReport at 295 (“The mounting number 2, which is between the strut and the floating body, must be mounted in accordance with [2]. The important areas to study in this mounting are where the base plate is screwed into the floating body and where the wing profile is to be riveted and/ or glued to the base plate”), 276 (“The longer bolts join the base plate with the floating body and are slightly shorter than the thickness of the floating body, which allows nuts to be set into the floating body.”), 276 (“Figure 3. Base plate for joining the strut and floating body”).



Ex-1003-EvoloReport at 276, FIG. 3.



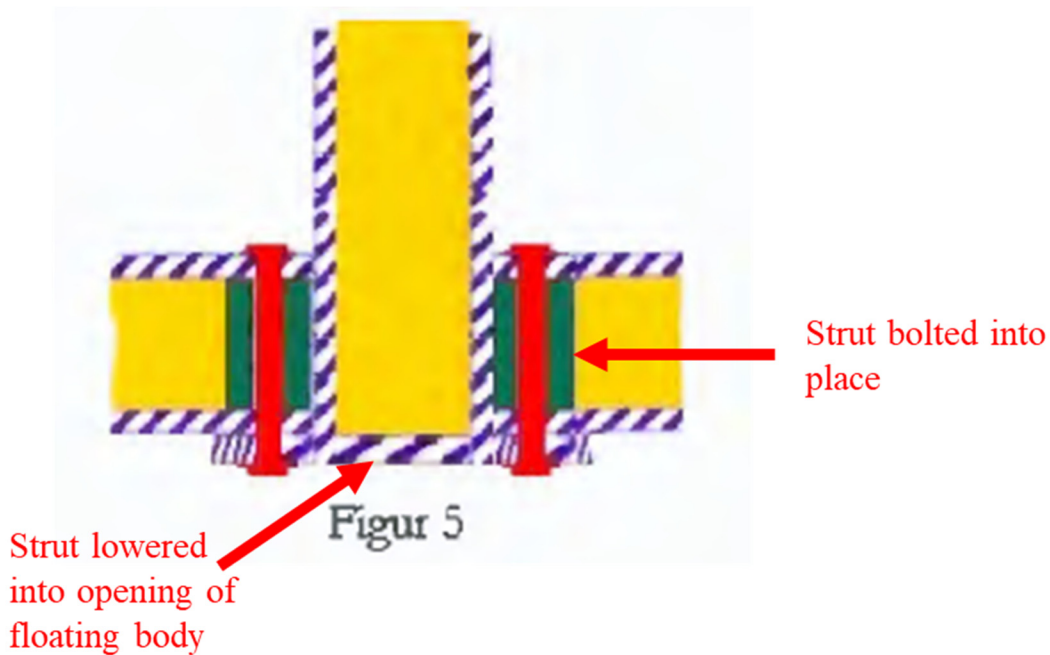
Id. at 277, FIG. 5.

120. In addition, EvoloReport teaches that the fitting is detachable. Ex-1003-EvoloReport at 275 (“The structural design of the strut is dictated partly by the strength and stiffness requirements according to [I] and partly by the practical requirements for the strut such that the strut must...be **detachable** from the floating body to facilitate transport.”), 277 (“Structure The arrangement with a load-bearing steel shaft and composite profile meets the requirements set out in the introduction to this report, including **demountability**, cabling space and module construction.”). This is consistent with what a POSITA would consider to be “detachable.” That is, A POSITA would have understood a fitting secured to something else via screws or bolts to be detachable.

8. **Claim 22: A watercraft in accordance with claim 21, wherein the detachable fitting is configured to fit into a complimentary opening in the flotation device.**

121. EvoloReport renders obvious a detachable fitting that is configured to fit into a complimentary opening in the flotation device. As discussed previously in ¶¶119-120 with reference to claim 21, EvoloReport teaches a strut that has a detachable fitting.

122. EvoloReport also discloses that various interconnection points in Evolo, which includes the connection between the floating body and the strut, can be implemented by inserting the end of the strut into a hole in the floating body, which would then be secured together with bolts. Ex-1003-EvoloReport at 227 (“A further option is that, like the fin solution on the majority of suction boards, to **mill a through hole in the floating body and that an insert, see figure 2, is attached to the strut. This strut is then lowered from above into the floating body and bolted in place**, as illustrated in Figure 5.”), 225 (“This work aims to provide a summary of the possible fastening techniques that are possible in the points between e.g. hydrofoil [*sic*] and floating body, and to give suggestions on which techniques should be used for each area”). According to EvoloReport, this allows for the core material to contribute to load absorption. EvoloReport at 227 (“The construction in this case means that the torque is partly absorbed by...the insert which abut[s] against the surface layer....”).



Ex-1003-EvoloReport at 227, FIG. 5.

123. In light of these teachings, a POSITA would have found it obvious to extend either a portion of the base plate or the strut of EvoloReport into an opening in the core of the floating body. EvoloReport teaches that bolts and the battery are inserted through openings in the floating body, so a POSITA would have been well aware that other components could extend into an opening in the floating body as well. Therefore, extending either the base plate or the end of the strut (or even both) into an additional cutout in the floating body would allow the core material of the floating body to absorb additional loads, as expressly taught by EvoloReport.

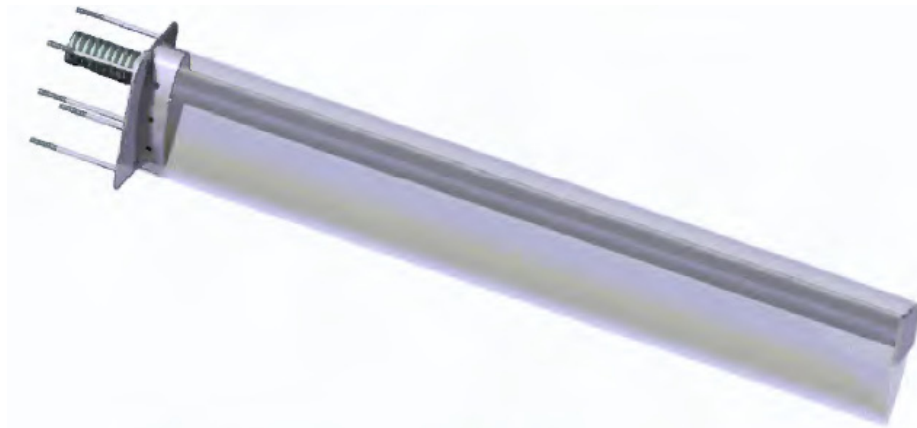


Figure 5. Structural arrangement for the strut.



Figure 4. Joining the parts of the strut.

Ex-1003-EvoloReport at 277, FIGs. 5, 4. I note that Woolley, which is a similar hydrofoil-based watercraft with a strut and a board, discloses a similar tongue 106 at the end of a strut for insertion through an opening in the board:

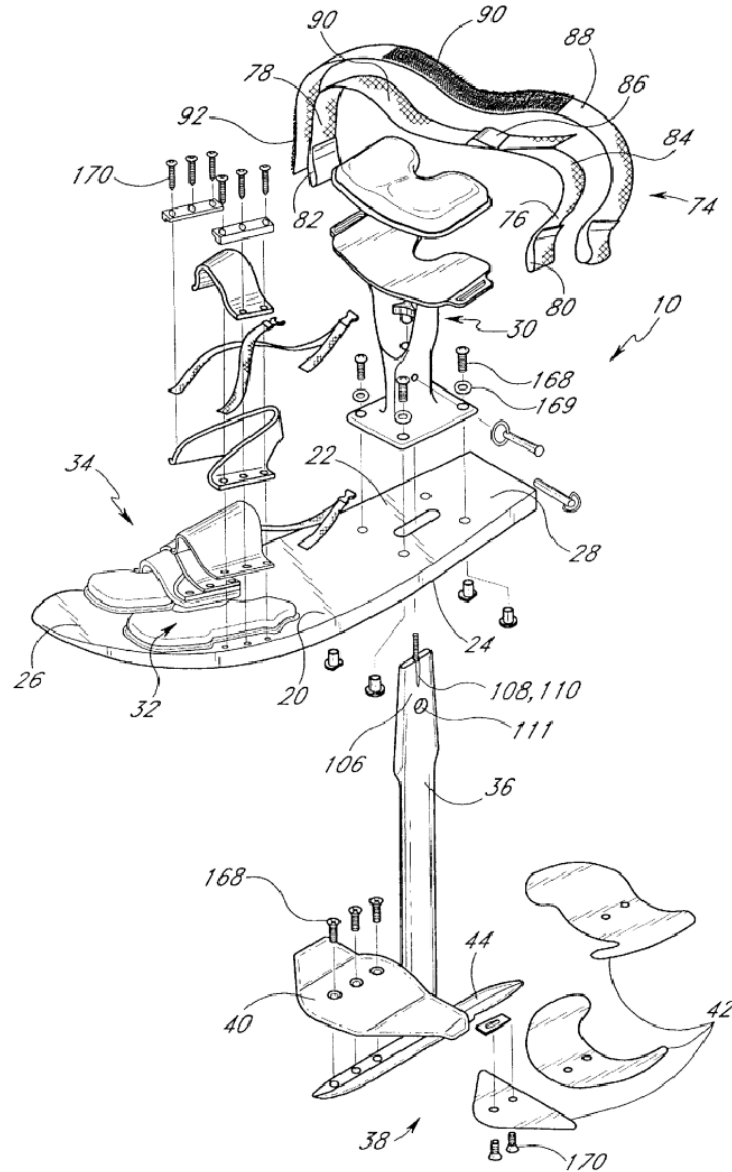


FIG. 2

Ex-1011-Woolley at FIG. 2; *see also id.* at 10:4-28. This confirms that it would have been obvious to a POSITA to extend the detachable fitting into an opening into the floating body.

124. A POSITA would have had a reasonable expectation of success in making this modification, namely to extend a portion of the base plate or strut into

the core of the floating body. EvoloReport itself is not limited to one particular embodiment, and instead teaches that modifications to mounting techniques are contemplated and within the skill of a POSITA. Ex-1003-EvoloReport at 228 (“With regard to the mounting points analyzed in this case, there are essentially three basic principles that can be used and these can then be combined to achieve the requirements that are set.”). Likewise, I have reviewed the ’659 patent, and have not found any disclosure indicating criticality of the disclosed fitting. To the contrary, the ’659 patent recognizes that “[a]ny other attachment approach may be used” while leaving such alternative approaches to the skill of a POSITA. Clearly, these types of modifications are well within (and even below) the level of ordinary skill.

9. Claim 23: A watercraft in accordance with claim 22, wherein the fitting is configured to be secured within the complementary opening by at least one of a bolt, a pin, and a latch.

125. EvoloReport discloses the fitting is configured to be secured within the complementary opening by at least one of a bolt, a pin, and a latch. Ex-1003-EvoloReport at 276 (“**The longer bolts join the base plate with the floating body** and are slightly shorter than the thickness of the floating body, which allows nuts to be set into the floating body.”), 227 (“A further option is that, like the fin solution on the majority of suction boards, to mill a through hole in the floating body and that an insert, see figure 2, is attached to the strut. This strut is then lowered from above into the floating body and bolted in place, as illustrated in Figure 5.”), 276 (“Figure

3. Base plate for joining the strut and floating body”), 277 (Figure 4. Joining the parts of the strut), 277 (“Figure 5. Structural arrangement for the strut”).

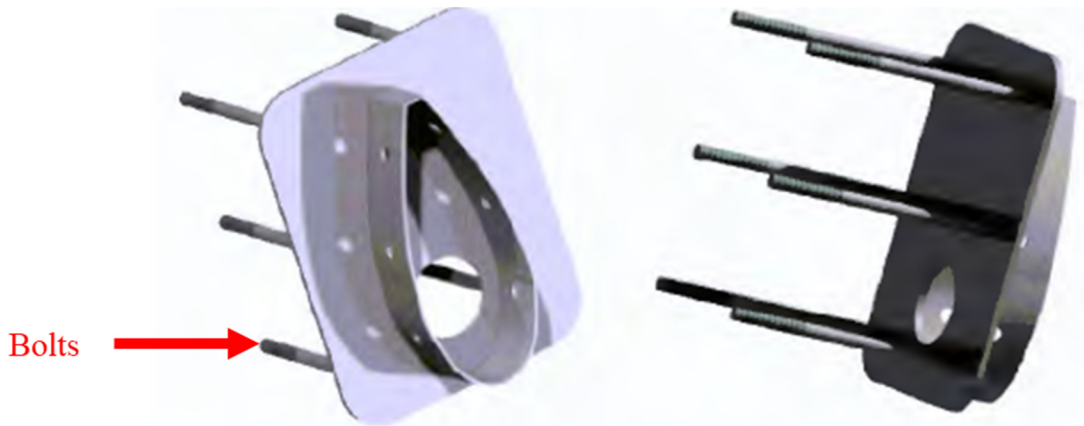


Figure 3. Base plate for joining the strut and floating body.

Ex-1003-EvoloReport at 276, FIG. 3.



Figure 4. Joining the parts of the strut.

Id. at 277, FIG. 4.

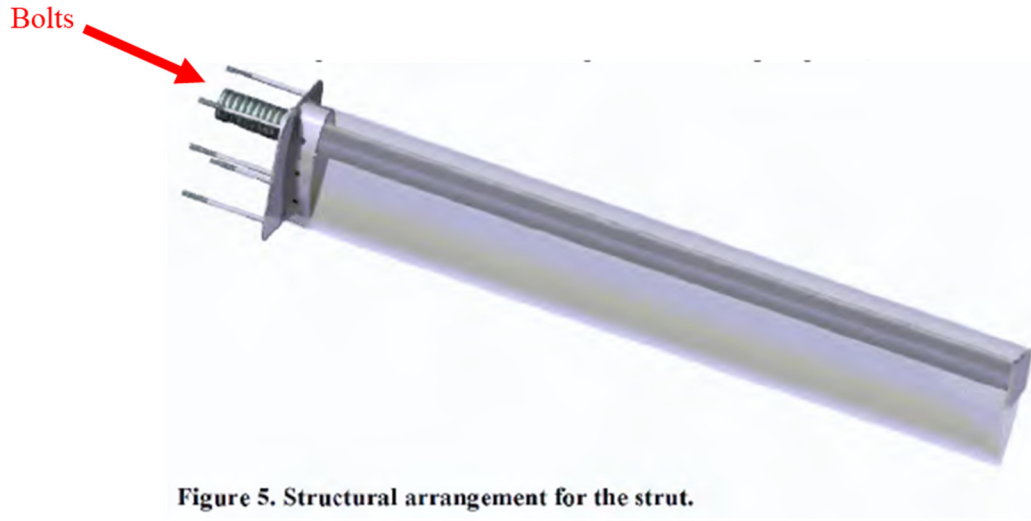
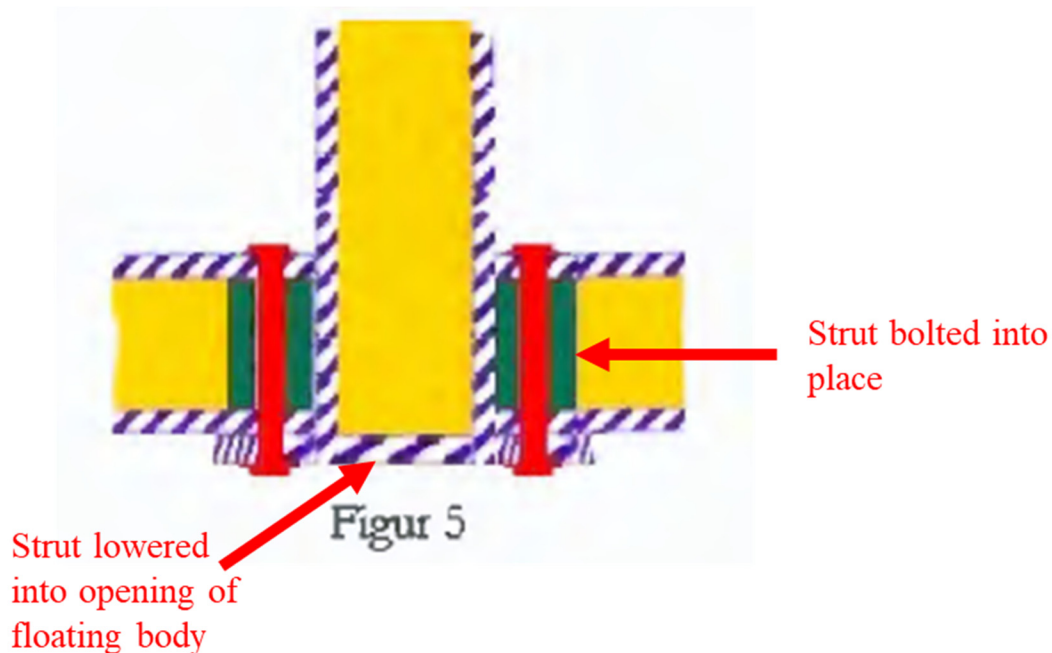


Figure 5. Structural arrangement for the strut.

Id. at 277, FIG. 5; *see also* Ex-1003-EvoloReport at 227 (“A further option is that, like the fin solution on the majority of suction boards, to **mill a through hole in the floating body and that an insert, see figure 2, is attached to the strut. This strut is then lowered from above into the floating body and bolted in place**, as illustrated in Figure 5.”), 225 (“This work aims to provide a summary of the possible **fastening** techniques that are possible in the points between e.g. hydrofoil [*sic*] and floating body, and to give suggestions on which techniques should be used for each area”).



Ex-1003-EvoloReport at 227, FIG. 5.

10. Claim 26: A watercraft in accordance with claim 1, further comprising a safety device for monitoring the presence of a user on the flotation board.

126. EvoloReport discloses a safety device for monitoring the presence of a user on the flotation board.² EvoloReport teaches the use of “a dead man’s switch, or so-called kill switch” to ensure the safety of the user. Ex-1033-EvoloReport at 185, *id.* at 126-127 (“In order for the propeller to stop immediately in the event of a fall, some form of deadman switch is required. This can either be solved by a classic

² The claim term “flotation board” is not present in claim 1. For purposes of this IPR, I have been asked to assume “the flotation board” refers to “a floatation device” in claim 1 of the ’659 patent.

dead man's switch in the form of a line which, if it is pulled, turns off the power. Since Evolo will require movement of the body while driving, this may be perceived as limiting. An alternative is therefore a throttle control that requires constant pressure to provide propulsion and springs back as soon as it is released and thus turns off the power.”). As is well known in the art, a dead man's switch or kill switch is designed to be set off when a user falls off the floatation device. *Id.* Therefore, a POSITA would have understood that a dead man's switch or kill switch monitors the presence of a user on the floatation device by monitoring for when the user has fallen off.

11. Claim 27: A watercraft in accordance with claim 1, wherein the strut is the only strut connected with the flotation device.

127. EvoloReport discloses the strut is the only strut connected with the flotation device. As shown in the images below, only one strut is used to connect the hydrofoil to the floatation device. Ex-1003-EvoloReport at 4 (“Figure 2. General arrangement of Evolo”), 7 (**The strut** is the part that connects the floating body and the hydrofoil.”). This is confirmed by the images below.

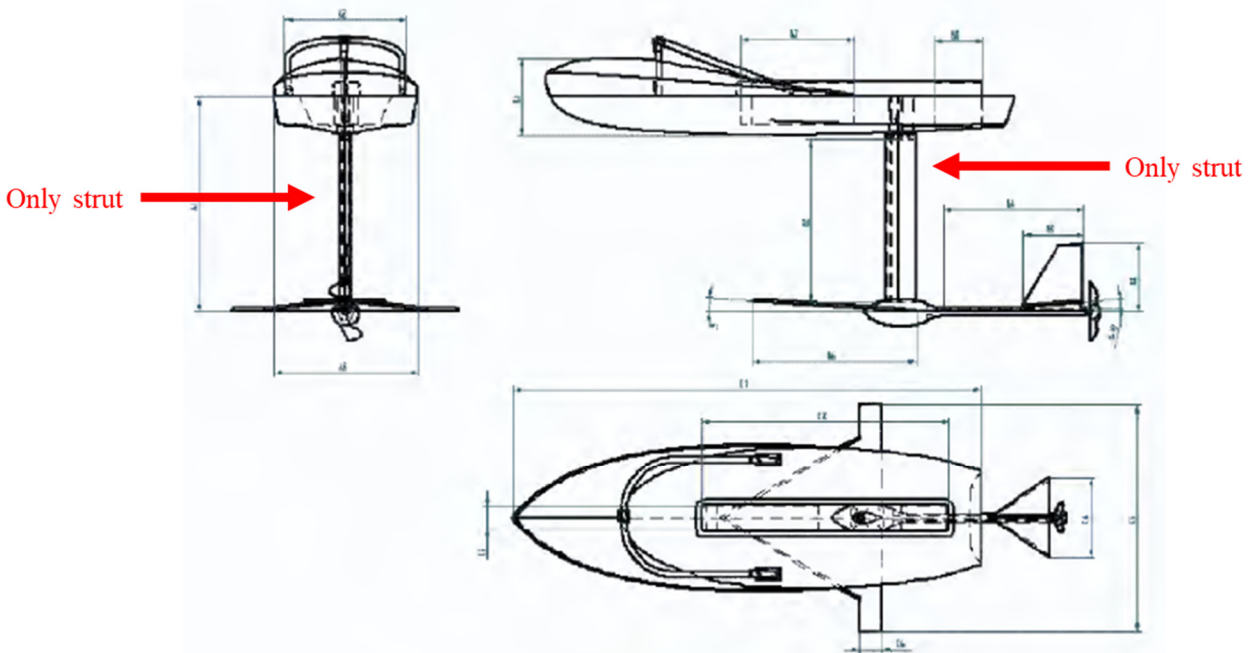
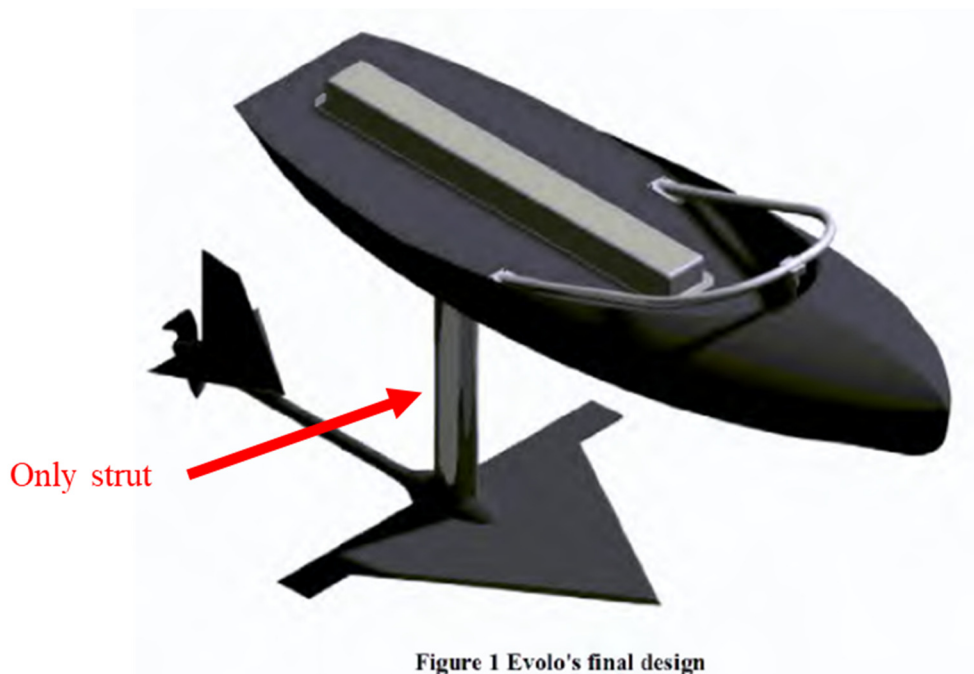


Figure 2 General arrangement of Evolo

Ex-1003-EvoloReport at 4, FIG. 2.

128. Similarly, the flotation devices that lack handles and/or protrusions discussed with reference to limitation [16A1] also utilize only one strut:



Ex-1003-EvoloReport at 3, FIG. 1.

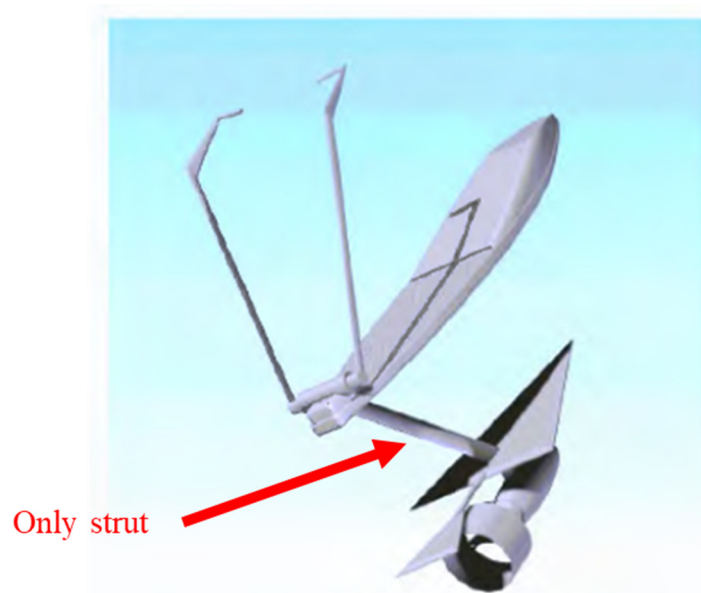
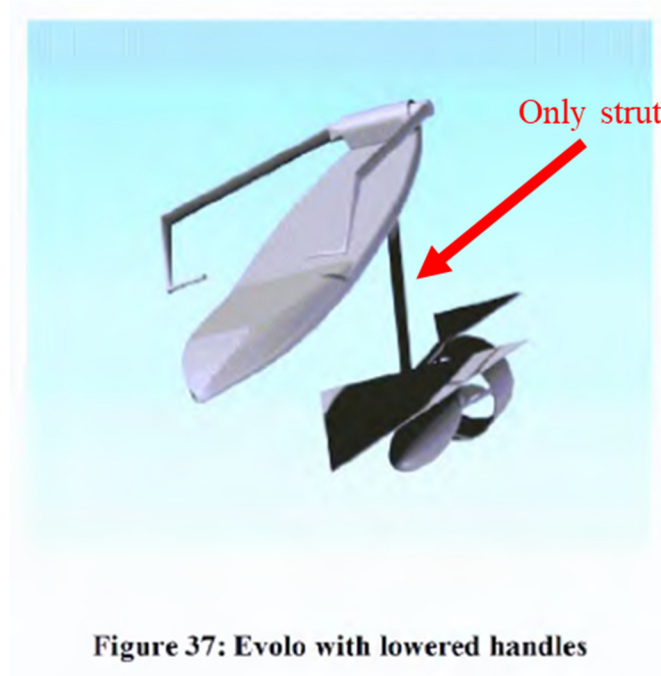


Figure 36: Evolo with raised handles

Id. at 332, FIG. 36.



Id. at 333, FIG. 37.

12. **Claim 28: A watercraft in accordance with claim 1, wherein the propulsion system includes a motor speed controller contained in a watertight compartment integrated into the flotation device.**

129. EvoloReport discloses a watercraft having a watertight compartment integrated into the flotation device. The watertight compartment of EvoloReport is shown by the grey plates in the below Figures 11 and 12. Ex-1003-EvoloReport at 550, 327 (“[T]his throttle control should be placed **inside the waterproof battery container** that encloses the top of the mounting of the strut.... This is the critical point of the cable routing due to the fact that **the battery container must be waterproof.**”).



Ex-1003-EvoloReport at 550, FIGs. 11-12. These watertight compartments house the batteries. Ex-1003-EvoloReport at 550 (“The floating body has sufficient volume to be able to stay afloat with the driver. **It should also have room for batteries.**”).

130. EvoloReport further discloses including additional electronics (i.e., the throttle, lanterns, and a display screen) in the watertight battery compartment. Ex-1003-EvoloReport at 327 (“[T]his throttle control should be placed **inside the waterproof battery container** that encloses the top of the mounting of the strut.”); Ex-1003-EvoloReport at 524 (“A slightly larger volume is also required for other reasons **such as containing batteries and electronics.** The vision is that **this volume should also be able to contain a waterproof storage compartment, a clear LCD screen with information about speed, battery level, depth, position, etc., and lanterns.**”)

131. Although EvoloReport discusses incorporating both the throttle and batteries into the watertight compartment, EvoloReport specifically chooses to use a Torqeedo motor largely because the Torqeedo was already available and was provided with all the required components in a preassembled package. Ex 1003-

Evoloreport at 180 (“The motor available today is a Torqeedo Cruise 2.0R....The **advantages of this system are that it is a complete driveline. Control systems are available and can be modified to work on Evolo.**”); Ex 1003-Evoloreport at 491 (“There are several options on the market today in terms of **ready-made electric motor concepts** for marine use. The method would be to source a product... then **remove the excess parts to build the motor and electrical system into the Evolo’s design.**”)

132. Evoloreport does not specifically disclose whether the motor speed controller is contained within the watertight motor pod or within the watertight battery container as Evoloreport drafters purposely chose the already completed Torqeedo motor unit. Ex 1003-Evoloreport at 8 (“The throttle...is designed like a bicycle brake, see Appendices 20 and 44, and **its wiring is passed through the strut down to the motor and its control unit.**”); *Id* at 181 (“When it comes to controlling the motors, there is no major difference as **Torqeedo’s options include complete systems** and VIAB’s **only need some form of potentiometer to regulate the current.**”); *Id* at 498 (“Since **most industrial and marine motors on the market, eg Torqeedo, are asynchronous motors**, there is a need to summarize their function and control... Since the motor control of asynchronous motors is of a control technology type and that the skills required to manufacture an own system are not available in the project today, **it is strongly recommended to purchase an already**

completed system, adapted to the motor that is finally chosen for Evolo.... **Due to the complexity of motor control of asynchronous motors, it is strongly recommended to use the motor manufacturer’s own control system.”)**

133. EvoloReport discloses obtaining alternative engine systems and that a control unit would need to be obtained and connected with the chosen motor. Ex1003-EvoloReport at 189-190 (“The purpose of this study is to make a benchmarking of what opportunities there are to develop your own motor solution instead of modifying an existing one and what consequences and opportunities it gives the project.... **Another challenge is that such an motor requires control. This is not built yourself.”); *Id.* at 193-194 (“The company could also sell a control unit for about 350 dollars plus shipping.... **The advantage of these motors is that they are completely ready and ‘only’ to integrate and connect with a control unit”).****

134. EvoloReport also discusses integrating a control unit (i.e., a potentiometer) near the handle mounted throttle control. Ex 1003-EvoloReport at 184 (“This has a great advantage in view of the fact that **the potentiometer, or control unit for the motor, can be placed separately from the handle** and that the handle can then be moved more easily.... The cable to the potentiometer can be selected as a regular bicycle brake cable. **If the motor is a torquedo, the wiring to the motor bulb**, which is an ordinary telephone cable with connectors at the ends,

can be easily spliced and extended, which **provides easy movement and separation of handles, control unit and motor.**"); *id.* at 185-186 ("The components are easy to procure or manufacture and **allow a wide variety of final placement.** However, **the control itself should not be made too far** as it will then be pulled obliquely if you do not apply the throttle in the middle of the control.").

135. EvoloReport states that the throttle control for the Torqeedo motor, should logically be located in the watertight battery container to ensure that the throttle control will always be dry. Ex-1003-EvoloReport at 327 ("Preliminarily, this **throttle control should be placed inside the waterproof battery container** that encloses the top of the mounting of the strut. This means that **the throttle control will always be dry and is currently the logical choice....** This is the critical point of the cable routing due to the fact **that the battery container must be waterproof** and the cable must be pulled in such a way that they do not destroy it.") EvoloReport thus teaches that it is important to keep sensitive electronics, such as the batteries and throttle controls, dry to prevent water damage.

136. Accordingly, a POSITA would have been motivated, based on EvoloReport's own teachings, to incorporate the motor speed controller into the watertight compartment of the flotation device if a preassembled waterproof engine were not used.

B. Ground 2

137. EvoloReport in combination with Woolley and Frank renders claim 26 obvious under 35 USC §103.

1. Claim 26: A watercraft in accordance with claim 1, further comprising a safety device for monitoring the presence of a user on the flotation board.

138. EvoloReport in view of Woolley and Frank renders obvious a safety device for monitoring the presence of a user on the flotation board. As previously discussed in ¶126 with reference to this claim, EvoloReport discloses a dead man's or kill switch.

139. If this limitation further requires monitoring for the presence of a physical object on the flotation Board,³ Frank teaches an infrared camera ("safety device") that obtains image data and monitors for a "man overboard" situation ("monitoring the presence of a"). Ex-1027-Frank at 11:60-64 ("FIG. 3B shows one embodiment of an infrared processing technique 320 as described in reference to block 225 of FIG. 2. In one implementation, **the infrared processing technique 320 comprises a man overboard mode of operation for maritime applications.**"), 19:29-34 ("Next, the obtained image data may be processed (block 714). In one implementation, **the obtained image data may be processed using the man**

³ I do not see any examples of devices that would do this in the '659 patent specification.

overboard mode of operation 320 of FIG. 3B to collect image data to detect an object, such as a person, falling into or in the water proximate to watercraft 180.”), 19:62-67 (When a man overboard condition is suspected or determined, an operator (e.g., crew member) may be alerted or notified (block 722) so that a rescue action may be initiated. In various implementations, this alert or notification may comprise an audio signal and/or visual signal, such as an alarm, a warning light, a siren, a bell, a buzzer, etc.”).

140. A POSITA would have found it obvious to implement Frank’s infrared man overboard detection technique in the floatation board of EvoloReport. EvoloReport makes the safety of the user on the floatation board a priority, and discloses using many different techniques. Ex-1003-EvoloReport at 123 (“In most contexts during the development of Evolo, safety has been the subject of discussion, partly in connection with the experiments, but also for the final product.”), 226 (“As point 1 marks the transition from the strut into the floating body, this is the point in the structure that will probably be exposed first to the largest torque [1]. However, **a combination of several techniques can be used** to increase safety.”), 401 (“**The safety of the user is of the utmost importance** during testing.”), 404 (“**[S]afety plays a decisive role**, how should it be handled? The test pilots were both run over by the craft and fell on the wings.”), 407 (“Other safety aspects were also brought up, when the test pilots both fell on the wings of the craft and were run over. These

observations are important to communicate to other project groups and work to minimize these risks is recommended by the experimental group.”), 516 (“In addition to the safety details mentioned in the requirements specification, i.e. dead man’s switch and protection against the propeller, it should also be verified that the safety of all operations is high and that recommendations from the safety analysis that was done in the autumn are followed. It is mainly the person who is responsible for the execution of various experiments who should also think extra about safety. However, all project members should consider their own safety and that of others.”). The EvoloReport disclosure recognizes additional safety measures may be helpful or even required. *Id.* at 124 (“The purpose of this report is to identify risks to the driver of Evolo and trial participants and to suggest solutions to minimize these and in some cases point out factors that need to be further developed with regard to technical solutions.”).

141. In light of EvoloReport’s discussion of safety, a POSITA would have been motivated to add the additional safety device (infrared camera) disclosed in Frank with Evolo’s hydrofoil watercraft. This would have yielded the predictable result of monitoring the presence of a user on the floatation board in order to better determine if the user has fallen off. This would have served as an alternative to, or an additional check on the kill switch. It is well known that redundancy is beneficial when it comes to safety.

142. A POSITA would have had a reasonable expectation of success. For example, monitoring cameras were well known at the time, so incorporating them into another watercraft would have been within, if not below, the level of ordinary skill in the art. The disclosure of Frank is far more detailed than the disclosure of the '659 patent, which only identifies a generic “safety device[]” and that “may monitor the presence of a user on the flotation board 101” without disclosing any more detailed aspects of the safety device (what type of sensor is used, the form factor, the location, etc.) or how it is implemented. Ex-1001-USP659, 4:52-56. The patent therefore confirms that it is well within the level of skill of a POSITA to design, select, and implement a safety device for monitoring the presence of a user.

X. SECONDARY CONSIDERATIONS

143. I have reviewed the file history for the '659 patent and its reexamination proceeding. In the reexamination proceeding, the Patent Owner presented some discussion of secondary considerations. Ex-1024-659-Reexam, 313-315. I have reviewed these discussions, which were based mostly on a declaration by its the Patent Owner's co-founder and CEO, Nick Leason. I note that in the response to Patent Owner's arguments, the Examiner did not credit the discussion of secondary considerations as a reasons for finding the claims patentable. Ex-1024-659-Reexam, 313-315, 6-7. I have been asked to evaluate Patent Owner's and Mr. Leason's allegations. Patent Owner's discussion of secondary considerations does not change

my opinions above that the new and amended claims of the '659 patent are obvious.

I reserve the right to respond to any additional evidence or arguments that Patent Owner provides on the topic of secondary considerations.

144. Commercial Success (Ex-1024-659-Reexamination, 228-229): I disagree that there is evidence of commercial success with nexus to the '659 patent claimed invention. In his discussion, Mr. Leason does not even identify a specific product on the market, and he does not provide any evidence or analysis that a product practices the claims of the '659 patent. I also note that Mr. Leason does not explain or identify any nexus between the claims of the '659 patent and the successes he proclaims (which are not based on any evidence). In light of Mr. Leason's comments, the commercial success may instead have resulted from being first hydrofoil board to market. His declaration does not address that possibility. Mr. Leason also discusses his company's market share and licensing, but I did not see any evidence to back up his calculations or evidence of a license to a third party. Without that evidence, it is impossible to determine the validity of his statements or identify a nexus.

145. Copying (Ex-1024-659-Reexamination, 229-231, 253-263): I have reviewed Mr. Leason's and Dr. Jacob Langelaan's (the '659 patent inventor upon whom Mr. Leason relies) declarations, but do not see any evidence of copying in their declarations. For example, neither provide any direct comparisons between

PO's product and competitors' products or between competitors' products and the '659 patent claims. Dr. Langelaan presents a claim chart, but there is no evidence in that chart aside from generic images and his own assertions. Ex-1024-659-Reexamination, 253-263. I reserve the right to respond to any evidence of copying that Patent Owner provides in this proceeding.

146. **Long-felt Need (Ex-1024-659-Reexamination, 231-232):** I disagree that there is evidence of a long-felt need with nexus to the '659 patent claimed invention. Aside from his conclusory testimony, Mr. Leason's sole evidence for long-felt need is the absence of a product that practiced the claimed invention on the market prior to the '659 patent. Moreover, Mr. Leason fails to establish that there was a long-felt need for a personal hydrofoil watercraft that lacked moveable surfaces on the hydrofoil, as claimed.

147. **Failure by Others (Ex-1024-659-Reexamination, 232-233):** I disagree that there is failure of others with nexus to the '659 patent claimed invention. The only example of a failure that Mr. Leason offers is his own company. I note that Mr. Leason only discusses his own recollection, which is not corroborated by any supporting documentation. Importantly, Mr. Leason actually admits that his early failures were the result of insufficient power or difficulty in riding, which contradicts his conclusion that his failure resulted from the lack of a hydrofoil with

no moveable surface. I could not find any example of an attempt to use a hydrofoil with moveable surfaces that failed as a technical matter.

148. **Unexpected Results (Ex-1024-659-Reexamination, 233-234):** I disagree that there were unexpected results with nexus to the '659 patent claimed invention. Mr. Leason's and Dr. Langelaan say that POSITAs would have expected that a hydrofoil board would require moveable surfaces. But that contradicts the EvoloReport reference, which studied a number of different features on hydrofoil boards, but did not once propose a moveable or active hydrofoil surface. I reserve the right to respond to the many other flaws in Dr. Langelaan's analysis regarding hydrofoils and the prior art (Ex-1024-659-Reexamination at 242-253, which is conclusory and lacks evidentiary support. As one example, Dr. Langelaan's equations are simply generic equations describing stability and trim conditions (common terms in the art) of aircraft that one could find in any undergraduate level textbook. I have taught this subject matter to undergraduates (i.e., persons of *less than* ordinary skill in the art before). Moreover, Dr. Langelaan leaves out important terms that would apply to water, which is much denser than air and does not offer any analytical techniques for accounting for the center of gravity, which he focuses on in his analysis of the prior art. Unlike for airplanes, where the mass and inertia of air can sometimes be ignored, those terms would be necessary to consider in the context of a water-based hydrofoil. Dr. Langelaan's reliance on these generic

equations without providing any specific solutions or adjustments for hydrofoils in water demonstrates that developing a hydrofoil that satisfies the stability and trim conditions would have been well within the level of ordinary skill in the art. As another example, Dr. Langelaan belies the lack of a tow rope like Woolley's in the Braden reference (*see* Ex-1024-659-Reexamination at 251-253), but I note that the Woolley reference itself makes no statement that a tow rope is essential to the disclosed stability. That tow rope, like the weight of a user, the drag of the water and air, and other factors, would simply be another input to take into account when answering the question of what form a hydrofoil should take (an answer that the '659 patent does not even provide).

149. **Industry Praise (Ex-1024-659-Reexamination, 234-235):** I disagree that there was industry praise with nexus to the '659 patent claimed invention. I have reviewed the praise that Mr. Leason identified, but none of it specifically refers to the purported invention of the '659 patent, which is a hydrofoil with no moveable surfaces. I therefore do not see any nexus between this (unsubstantiated) praise and the challenged claims of the '659 patent.

XI. AVAILABILITY FOR CROSS EXAMINATION

150. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

XII. RIGHT TO SUPPLEMENT

151. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises and to take into account new information as it becomes available to me.

XIII. JURAT

152. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: September 16, 2024

/Stefano Brizzolara/
Dr. Stefano Brizzolara

EXHIBIT A

Stefano Brizzolara

Education	➤ M.S. “ <i>summa cum laude</i> ” in Naval Architecture and Marine Engineering, University of Genova, with special mention and recommendation for publication of the thesis “Design of a monohull fast ferry able to carry 450 passengers and 120 cars at a speed of 40 knots”, sponsored by Fincantieri that led to the creation of a new ship class.
<i>April 1994</i>	
	➤ PhD in Naval Architecture at the University of Naples Federico II (jointly with the Univ. of Genova) with the thesis “Theory and Application of Numerical Methods for the Hydrodynamic Design of High Speed Ships”.
<i>April 2000</i>	
Current	➤ Full Professor with tenure at Virginia Tech, Aerospace and Ocean Engineering.
Position	➤ Assistant Department Head and graduate program director
	➤ Virginia Tech Crofton Faculty Fellow (for distinction in research)
Previous	➤ Assistant Director of Research at MIT Sea Grant, managing a diverse portfolio of research projects about advanced ship design and coastal environment issues.
Positions	➤ Principal research Scientist and Lecturer in MIT Mechanical Engineering Department.
	➤ Founder of the MIT Innovative Ship Design lab, a laboratory dedicated to the development of new design and design tools for innovative ships, with principal support from ONR and DARPA.
	➤ Assistant Professor (with tenure) in the Department of Naval Architecture, Marine and Electrical Engineering of the University of Genova.
	➤ Founder and responsible of the Marine CFD Group (Univ. of Genova), a research group dedicated to the development and application of numerical methods for hydrodynamic in Ship Design, currently involved in several research projects with EU, ONR, Italian Navy and shipbuilding industry.
Specializations	➤ Stage (1992) at Danish Hydraulic Institute on numerical modeling of coastal and offshore hydrodynamics, with special lectures of M. Abbot.
<i>1993</i>	➤ WEGEMT course “Numerical Simulation of Hydrodynamics: Ships and Offshore Structures” in Ecole Central de Nantes, hold by M. Visonneau, G. Delhommeau.
<i>1994</i>	➤ Stage at Univ. of Madrid with G. Perez Gomez, inventor of the CLT propellers, on “design methods of unconventional propellers with tip end plates”
<i>1999</i>	➤ Course “Understanding, Modeling and Simulation of Turbulence” in Hamburg, hold by P. Bradshaw, H. Ferziger and M. Peric.
<i>2008</i>	➤ 16 ^a Summer School of Scientific Parallel Programming at the inter-university Supercomputing Center CINECA in Bologna.
<i>2009</i>	➤ Course in “Flow Simulation using Particles” at CECAM (Centre Européen de Calcul Atomique and Moléculaire) of Lausanne, hold by Prof. P. Koumoutsakos & G.H. Cottet
Awards and	➤ Finalist of the Ocean Discovery X-prize (sponsored by Shell) advising the VT Deep-X team, designing and building a system of coordinated 4000m depth rated AUVs.
Recognitions	
<i>2018</i>	➤ Calder Prize for best paper on the subject of high speed crafts published in the Transactions of the Royal Institution of Naval Architects in the year 2017-18
<i>2015</i>	➤ Mandel’s Prize for Excellence in Hydrofoil Research, as advisor of the PhD student Luca Bonfiglio

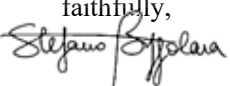
2014	➤	Qualified to Phase two (from 92 contenders to 20) of the Wave Energy Prize, sponsored by the US Department of Energy, as leader of the IOWEC team (MIT+Politecnico of Torino+FAU), proposing a new technology of Wave Energy Converter that uses gyroscopic devices to harvest energy motion of an oscillating floating body in waves and pitch resonance tuning tanks.
2013	➤	Elected member of the ISSC Special Committee V. ITTC, for the establishing common hydrodynamic analysis and design methods to estimate transient loads and motions in waves among the two institutions, 2015-2017.
2012-present	➤	Honorable Mention (second place) at the Mandel's Prize for Excellence in Hydrofoil Research, as advisor of the students V. Georgiadis, L. Faison and K. Miller participating with the work "Design and Assessment of a Super-High Speed, Hybrid Hydrofoil/SWATH Crew Boat".
2011	➤	Award for the Best Paper of 2011 in the Journal of Ships and Offshore Structure with a paper "Comparison of experimental and numerical sloshing loads in partially filled tanks" which review and validate results of numerical studies made in MARSTRUCT European Network of Excellence dedicated to the analysis of the response of marine structures to violent loads.
Dec. 2011	➤	Invited Seminar at MIT on " <i>Design and Hydrodynamics of High Speed Ships</i> ", organized by the MIT Center for Ocean Engineering.
Feb. 2011	➤	Invited Seminar at MIT on " <i>Design and Hydrodynamic Optimization of a New Family of Hybrid-SWATH Unmanned Surface Vehicles</i> ", organized by the MIT Center for Ocean Engineering and MIT Sea Grant College Program.
2010	➤	Visiting Professor at NURC (NATO Undersea Research Center) of La Spezia, summer/autumn 2010, for developing the design of an innovative Unmanned Surface Vehicle for persistent sea monitoring and UUV management.
Feb. 2010	➤	Invited Seminar on " <i>Prediction of slamming load by SPH method</i> " at the California Institute of Technology (Pasadena, CA) for an ONR sponsored seminar about Slamming loads on High Speed Ships, organized by Prof. G. Ravichandran (Aerospace Lab).
2003	➤	Grant from the University of Genova for the Best Research Proposal of Young Researchers in Engineering disciplines, about the design and testing in cavitation tunnel of an unconventional stabilizer fins
Professional Societies	➤	Royal Institution of Naval Architect, elected member since 2008
	➤	Society of Naval Architects and Marine Engineers, elected member since 1997
	➤	American Society of Naval Engineers, member since 2012
Service	➤	Member elect (US representative) of the ISSC Committee II.2, Ship Dynamic Response for the triennial 2013-2015.
2014 – present	➤	Member elect (US representative) of the ISSC-ITTC special Committee on Uncertainty Quantification of Waves and Wave Loads.
2019 – present	➤	Chair of SNAME H-10 panel: Computational Fluid Dynamics
2018 – present	➤	Associate Editor of the Journal of Ship Research, edited by Society of Naval Architects and Marine Engineers (US)
2014 – present	➤	In the Editorial Board of the International Journal of Maritime Engineering (IJME) and the International Journal of Small Craft Technology (IJSCT), formerly the Transactions of the Royal Institution of Naval Architects (UK).
2014 - present	➤	In the Editorial board of the Journal of Marine Science and Applications, Transactions of the Chinese Society of Naval Architects and Marine Engineers. Edited by Elsevier.

Service (cont.d)	➤ Academic advisor of the VT-SailBot team, that designs builds and competes with an autonomous sailing boat. Arrived 2nd in 2019. ➤ Academic advisor of the multidisciplinary inter-university (VT-MIT-UWI) team selected for the final of the U.S. Department of Energy Marine Energy Collegiate Competition (MECC)
Sabbaticals	➤ Visiting Peabody Associate Professor at MIT Mechanical Engineering department, from September 2011 to September 2012.
Professional Experience	➤ After graduation, I collaborated with Mario Caponnetto, at the time assistant professor at the Univ. of Genova, head of the CFD simulations team for the BMW Oracle team of the last two America's Cup editions, now in the Luna-Rossa syndicate. I specialized with him on the theory of panel methods for lifting bodies, developing a method for propellers analysis in cavitating conditions, referenced by ITTC as one of the first numerical methods in the field.
<i>Experimental research at Cavitation Tunnel</i>	➤ Immediately later, as duty officer of Italian Navy (1994-1996), I was assigned to the center of experimental hydrodynamics of the Italian Navy (C.E.I.M.M.) in Rome. I was responsible for running experimental tests on hydrofoils and propellers for Navy ships at the cavitation tunnel and participated to other civilian research, such as for instance bulbous keels for racing sailboats or fin stabilizers for fast ferries;
<i>Fincantieri Hydrodynamic Design Office (1996-2000)</i>	➤ Designer in the hydrodynamic design and research office of Fincantieri Naval Ship Division in Genova. Designs include: Fast Deep-V monohull ferries class (40 knots, 80-145m in length), SES ships, fast Corvettes (Comandanti class), Frigates (FREMM class), fast patrol boats (new Saettia class) as well as submarines (U-212 with fuel cells, in collaboration with HDW in Germany); hull appendages (rudders, fin stabilizers, interceptors) and naval ships propellers, following Fincantieri legacy of sophisticated propeller designs, with attention to cavitation and noise.
<i>EU Research in Fincantieri</i>	➤ Technical Responsible for Fincantieri of several research projects funded by European Community or NATO (CEPA10): design of SES large passenger ferries (HYDROSES), study of hydro-elastic coupling in the slamming phenomena (SEAWORTH), automatic optimization of ship hull forms with respect to resistance and seakeeping (HULLOPT, FANTASTIC), human factor in ship design (PERFAST).
<i>Rolls-Royce Syncrolift</i>	➤ Technical advisor for Rolls Royce Syncrolift (USA), for the whole design and installation of the biggest ever built Syncrolift plant in Venice (Italy). The 28,000t lift rated plant was successfully used to launch concrete-caissons from land to the sea. The floating caissons were towed and sunk in place from the foundations of the movable tilting doors of the <i>Mose</i> barrier system that protects the Venice lagoon against high tides. One of the most significant maritime works ever done worldwide.
<i>Schottel Ship Propulsion</i>	➤ Technical advisor for Schottel (Germany) in Italy, for design and analysis of azimuthal propulsion units (mechanical thrusters or electrical podded propellers) and CP propellers. I developed one of the first method to calculate the indirect towing capability of tugs with azimuthal thrusters (ship classification society approved).
<i>Consulting</i>	➤ Design and technical advisory for shipyards, marine propulsors manufacturer and ship and yacht design firms in Italy and worldwide.
Academic experience	➤ My PhD was on the numerical methods for ship design and in particular on the development of a <i>panel method for the prediction of wave resistance of mono and multihull fast ships</i>. The method, continuously updated, is among the few able to predict the far field wave wash of fast ships in shallow waters. Its robustness and accuracy was proven in many validation studies and recently in two projects for Italian Navy dedicated to the parametric optimization three frigate hull forms for wave resistance and seakeeping. Results were validated by dedicated tests at towing tank. Studies and results obtained are cited in several ITTC proceedings.

PhD

<i>Assistant Professor</i>	➤ After the period in Fincantieri, in 2000, I rejoined the University of Genova, department of Naval Architecture and Marine Engineering, as Assistant Professor, contributing to expand the research activities of the department in the field of numerical hydrodynamics for ship design. I was confirmed with tenure in 2003 and assigned the new course “Numerical Hydrodynamics in Ship Design”.
<i>Marine CFD Group</i>	➤ Few years later I founded the Marine CFD Group with a small group of my PhDs students and post-Docs involved in different projects dealing with development and application of numerical methods for ship hydrodynamics.
<i>MIT-MechE</i>	➤ Visiting Peabody Associate Professor at MIT MechE (2012-2013), leading the ONR sponsored research project “CFD methods for seakeeping and propeller analysis of SWATH vessels” at the AUV Design Lab of MIT Sea Grant. The research activity continued for another 4 years as reach scientist and associate director for research at MIT Seagrant
Teaching Experience	
<i>At Virginia Tech 2016 – present</i>	➤ Instructor of “Ship Dynamics” (AOE-4334) for the BS in Ocean Engineering ➤ Instructor of “Dynamics of High Speed Ocean Vehicles” (AOE-5444G) for the MS in Aerospace and Ocean Engineering ➤ Instructor of “Advanced Ship Dynamics” (AOE-5334) for the MS in Aerospace and Ocean Engineering ➤ Instructor of “Advanced Naval Architecture” (AOE-5304) for the MS in Aerospace and Ocean Engineering
<i>At MIT 2012-2016</i>	➤ Instructor (lectures and labs) “Design of Ocean Systems” (MIT 2.019) for the undergraduate degree in Naval Architecture and Ocean Engineering. ➤ Co-instructor (lectures and labs) “Marine Power and Propulsion” (MIT 2.611) for the Master degree in Naval Architecture, Ocean and Naval Engineering. ➤ Co-instructor (lectures) “Design Principles of Naval Vessels” (MIT 2.703) for the Master degree in Naval Architecture, Ocean and Naval Engineering
<i>2015</i>	➤ Co-instructor of (lectures and labs) “Design Principles of Ocean Vessels” (MIT 2.22) for the Master degree in Naval Architecture, Ocean and Naval Engineering.
<i>At U. Genova (IT)</i>	In 2003, I created the course “Numerical Hydrodynamics for Ship Design”, first of its kind in Italy. In 2009, I introduced the new subject Numerical Hydrodynamics for Yacht Design for the Master in Yacht Design in La Spezia, now taught by a former advisee of mine (now ass. prof.).
<i>2000 -2011</i>	➤ Instructor “Hull Geometry, Hydrostatic and Stability” for the BSc degree in Naval Architecture in Genova. About 100 students per year.
<i>2000-2003</i>	➤ TA of “Ship Resistance and Propulsion” and “Ship Dynamics” for the BS and MS in Naval Architecture, respectively. About 60 students per year.
<i>2003-2011</i>	➤ Instructor of “Numerical Hydrodynamics for Ship Design”, newly developed course for the MS in Naval Architecture. About 20 students per year.
<i>2009-2011</i>	➤ Instructor of “Numerical Hydrodynamics for Yacht Design”, for the MS in Yacht Design and Engineering of La Spezia Campus. About 35 students per year.
Publications	
The list of more than 250 publications and 6 patents is attached in the appendix.	
Research Projects	
PI of more than 55 projects funded by EU Commission, Italian Ministry of research, Italian Ministry of Industry, Italian Navy, European Defense Agency, Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA) and National Oceanic and Atmospheric Administration (NOAA). Detailed list is attached.	

Blacksburg (VA), June 15th 2022

faithfully,


Patents Grants and Pending Applications

1. S. Brizzolara (2005) “Stabiliser Fin”, European Patent #120138.3-2312, issued March 28, 2001. It is about a new type of fin stabilizer with particular devices able to increase the lift force and the hydrodynamic efficiency at high angle of attack. The new fins have been installed on a series of corvettes of the Italian Navy (NUPA) with positive results.
2. S. Brizzolara “Watercraft Device”. Italian Patent # GE2011A000011 (2011), US patent US8763546 B2 (2014). It is about an innovative Autonomous Surface Vehicle with unconventional SWATH hull form, optimized for minimum drag and motions in waves, for launching and recovering of Autonomous Underwater Vehicles.
3. S. Brizzolara “Watercraft Device”. Italian Patent # GE2011A000012 (2011), US patent US8820260 B2 (2014). It regards the design of a special hybrid HYSWATH Autonomous Surface Vehicle, with wing in ground effect, capable of reaching a max speed of 120 knots in Sea State 3, flying on two pairs of negative dihedral super-cavitating surface piercing hydrofoils. The patent includes the new design of the special dual-operating-mode, super-cavitating hydrofoil section.
4. E. B. Brizzolara, S. Brizzolara “Marine Tunnel Thruster”. US patent US9376186 B2 (2016). International EP 2 694 361 B1 patent grant (2017). A special design of the internal tunnel geometry and additional devices to improve the efficiency and thrust of long tunnel thrusters (with high length/diameter ratios). Applications cover auxiliary thrusters for maneuvering at zero speed (including station keeping, dynamic positioning) as well as ducted thrusters for main propulsion.
5. S. Brizzolara, C. Gray, L. Faison, M. Williams (2019). Stepped Cambered Planing Hull with Hydrofoils SCPH2 for lower drag and superior seakeeping in waves. US 10,189,544B2, patent grant. A technology for high speed planing crafts, consisting of a variable cambered bottom with a step, a particular shape after-body and a stern hydrofoil stabilizer. The new technology has been proven to cut the drag of conventional deep-V planing hulls by as much as 30% at high speed
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Invited Talks / Keynote Lectures

1. Oct. 2007, *Surfsience. Ocean Waves and Surfers*” Invited Seminar to the 2007 Edition of the Science Festival, Genoa, Italy.
2. Nov. 2007, “*SWATH+Hydrofoil = HySWATH. A new hybrid hull form of high technological content. Principal characteristics and Future Perspectives*”. International Propeller Club Seminars, Genoa Expo, Italy.
3. Jan. 2009, “*SPS – Sandwich Plate System A technological Revolution in the Construction and Repair of Ships*”, Propeller Club Seminars, Genoa Expo, Italy.
4. Feb. 2010, “*Prediction of slamming and other impulsive loads by SPH method*” California Institute of Technology (Pasadena, CA), organized by Prof. G. Ravichandran (Director of Aerospace Labs).
5. July 2011, “*Fast Ship: the past, the present and the future*”, invited seminar from ATENA, the Italian Association of Naval Architects, University of Genoa, Italy
6. March 2012, “*Computational Fluid Dynamics in the Design of High Speed Ships*”, invited Seminar at Univ. of Michigan, Department of Naval Architecture and Marine Engineering, Ann Arbor (MI).
7. April 2012, “*Hydrodynamics of Fast Ships*” three invited lectures in the class 2.22 of Prof. M. Triantafyllou, Design Principles of Ocean Vehicles.
8. Feb. 2013, “*Hydrodynamic Design Aspects of Very-High Speed Vehicles*”, Steven's Institute of Technology, Davidson Lab, Hoboken (NJ).
9. Sept. 2013, “*CFD methods in the Design of High Efficiency Ships*”, Polytec research institute and University College, Haugesund, Norway.
10. April 2014, “*Innovative Ship Design at MIT-iShip*”. Invited Lecture at Webb Institute of Naval Architecture and Marine Engineering, Glen Cove, NY.
11. June 2014, “*Assessing Ways to Protect Shorelines Against Flooding and Erosion by New High-Fidelity Numerical Models*”. MIT Climate Change Symposium, Sustaining Coastal Cities. MIT, Cambridge, MA.
12. July 2014, “*Innovative Aspect in the Design of Supercavitating Hydrofoils*”. SNAME H8 propeller and propulsors panel. MIT, Cambridge, MA.
13. Sept. 2014, “*Integration of CFD methods for Ship Design*”, Polytec research institute and University College, Haugesund, Norway.
14. Nov. 2014, “*Innovative Design Aspects of Very-High Speed Vehicles*”. Society of Naval Engineers, Northern New England Section, Portsmouth Naval Shipyard, NH.
15. Feb. 2015, “*Aero/Hydro–dynamic Design of Super-High Speed Marine Vehicles*”. Invited Lecture at the Dept. of Aerospace and Ocean Engineering, VirginiaTech, Blacksburg, VA
16. Aug. 2015, “*AUVs and Fast Autonomous Surface Crafts*”, Invited Lecture at Subsea Operations Conference, Haugesund (Norway)
17. Mar 2016, “*Innovative High Speed Ship Design*”, Invited Seminar at the Dept. of Aerospace and Ocean Engineering, VirginiaTech, Blacksburg, VA
18. Mar 2016, “*Modern Ship Design: Advantages Offered by the Intelligent Integration of Numerical Tools*”, invited seminar at the US Naval Academy, Annapolis, MD.
19. July 2016, “*Autonomous surface vehicles: the MIT experience and an outlook to the future*”, keynote lecture at Martech 2016, 3rd International Conference on Maritime Technology and Engineering, Lisbon.

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20. July 2016, “*Autonomous surface vehicles: the MIT experience and an outlook to the future*”, Invited Keynote Lecture at 3rd International Conference on Maritime Technology and Engineering, 4-6 July, Lisbon (PT)
 21. Feb. 2017, “*High Speed Planing Craft: The Evolution of a Species*”, Invited Talk at the SNAME SD-5 panel and HIS meeting, Army & Navy Country Club, Arlington, VA.
 22. June 2018, “*Innovative Ship Designs driven by Autonomous Operating Vehicles*”, Special scientific event featuring top Italian scientists conducting R&D in the marine sector in the US. Organized by the Italian Embassy in US, hold on board of the tall ship “Amerigo Vespucci”, in occasion of her return to Boston after more than 20 years.
 23. Feb. 2018, “*Uncertainty in Using Multi-Fidelity CFD for Ship Design*”, Fourth Joint ISSC/ITTC International Workshop. Egmond aan Zee (Amsterdam), The Netherlands.
 24. May 2019, “*Storm Surge Inundation Modelling and Protected Beach Replenishment*”, MIT Seagrant college program, 4 year review meeting, May 1st 2019, Cambridge, MA.
 25. July 2019, “*CFD , UQ , AI $\equiv$ Sex , Lies and Videotapes: déjà vu in Ocean Engineering*”, invited seminar at University of Genova, Faculty of Engineering, Genoa, July 4th, 2019.
 26. May 2021, “*Integration of CFD Tools in the Hydrodynamic Design and Analysis of Marine Vehicles*”, invited to the Monday Naval Architecture Lecture Series at Webb Institute, April 5th (virtual).
 27. July 2021, “*Current and Future perspectives for High Speed Small Attack Crafts*”, invited speech at First Workshop of Future Naval Technologies for the Italian Navy, July 1st (virtual).
 28. October 2021, “*The Universe of Autonomous Underwater Vehicles*”, invited speech at Port and Shipping Tech, part of the Genoa Shipping week conference and exhibition, Genoa, 2021.